

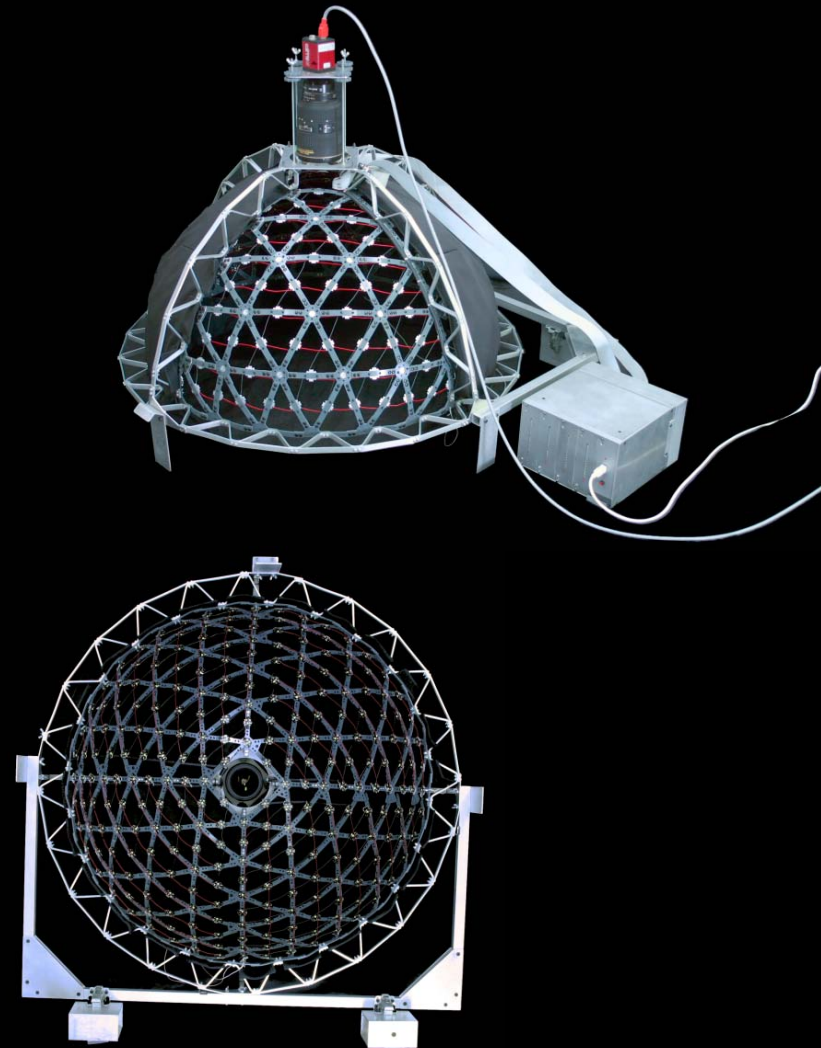
See the Surface. Imaging and measuring surface characteristics of medieval library materials by photometric stereo (RICH Project)

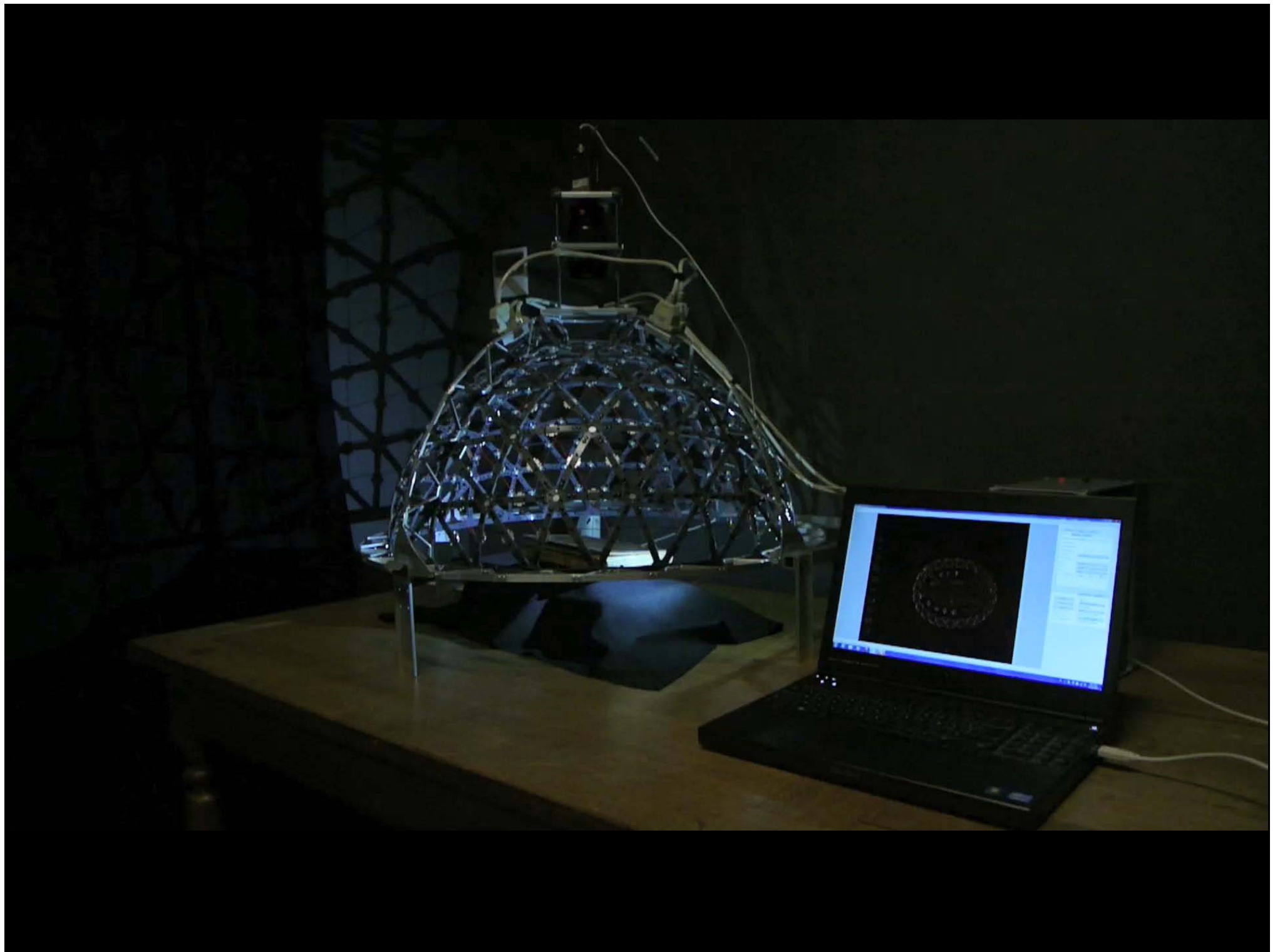
Lieve Watteeuw
Bruno Vandermeulen
Marc Proesmans

KU LEUVEN

Minidome

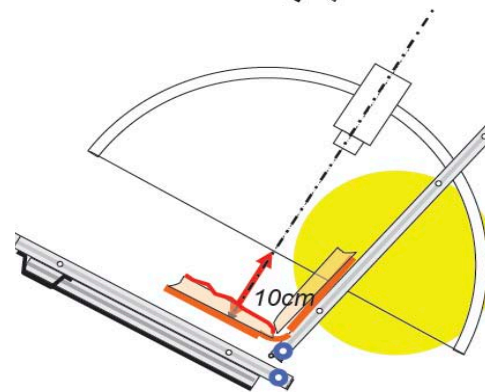
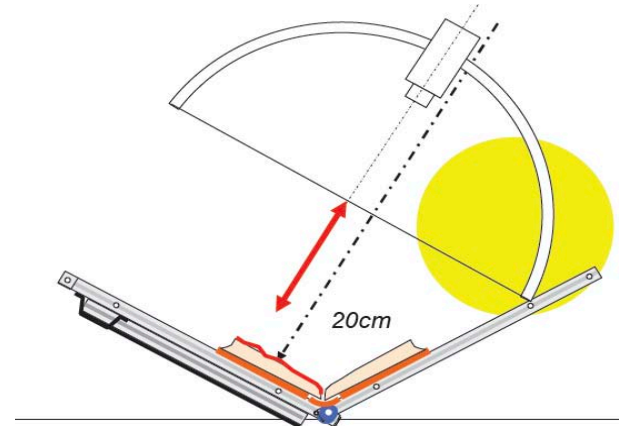
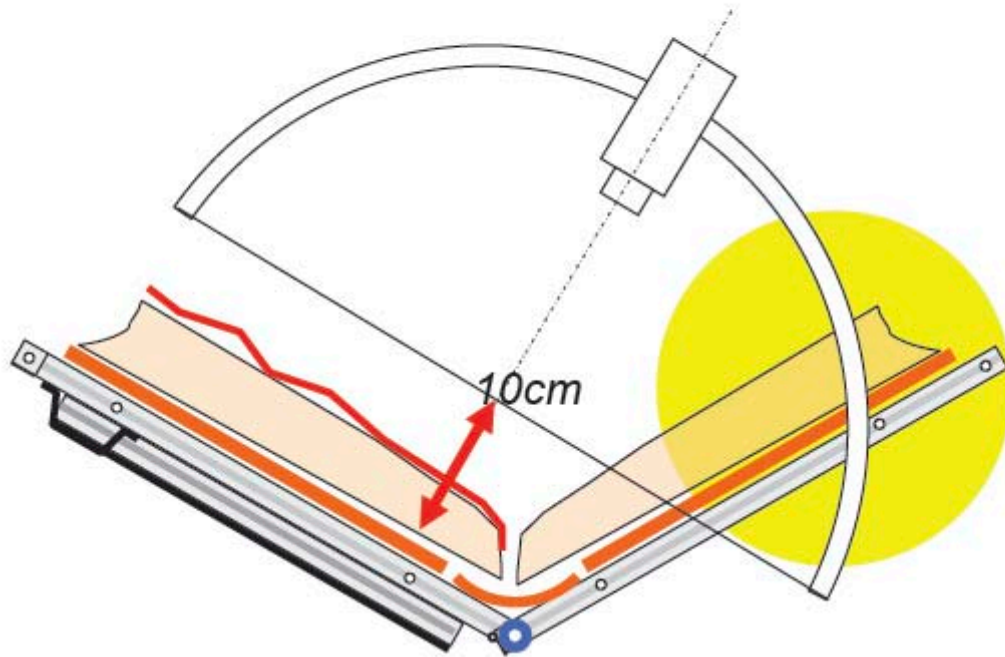
- Hemispherical structure
- 60 cm diameter
- 28MP camera
- Transportable
- Good for:
 - Small
 - Flat
- Problematic for:
 - Books
 - Manuscripts





Challenge

large volume 120° / d=10cm,





Solution

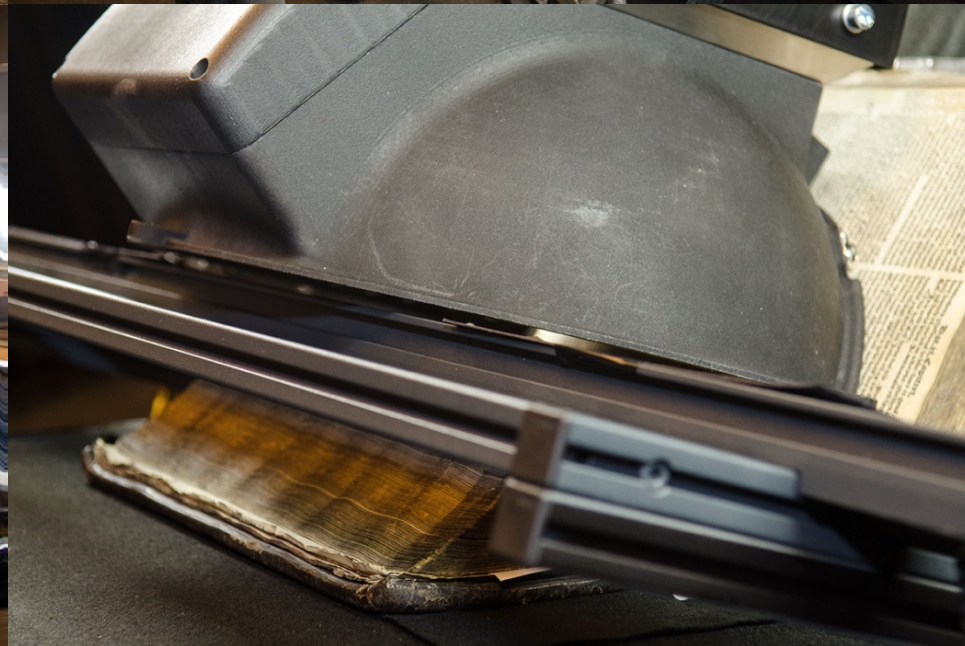
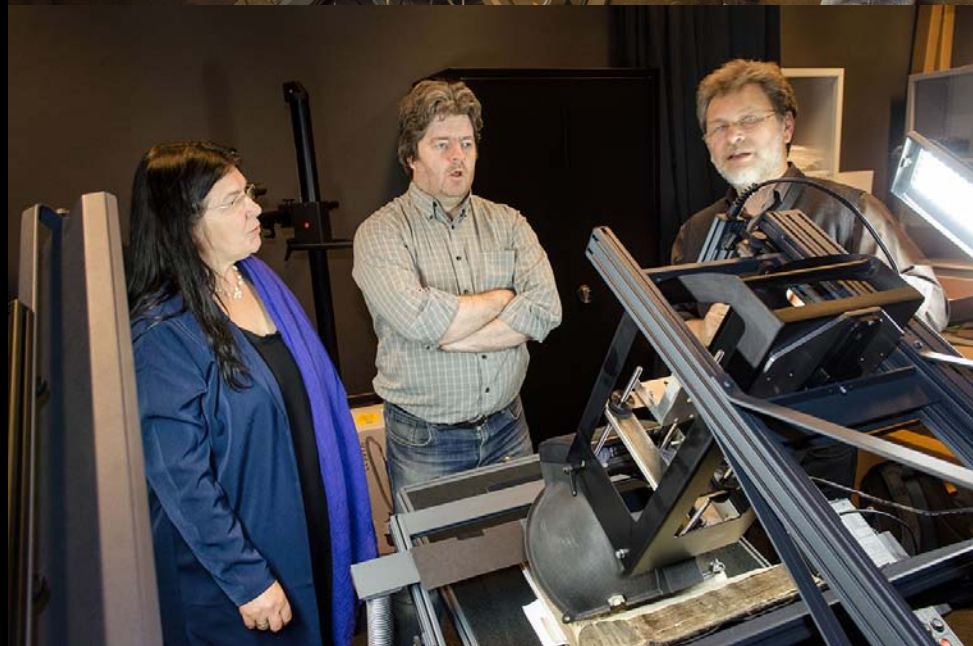
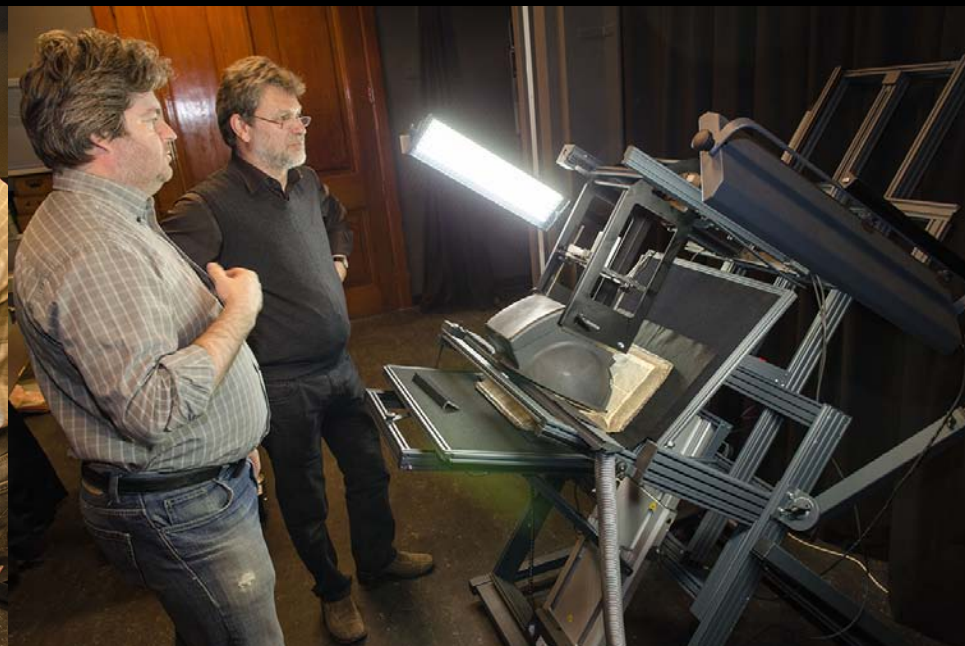
- Build a “Maxidome” to fit large manuscripts?
 - Transport
 - Rigidity / accuracy
- Book cradle for safe digitisation as imaging takes 3-5 minutes
 - Conservation Copystand developed by Manfred Mayer



Requirements new dome

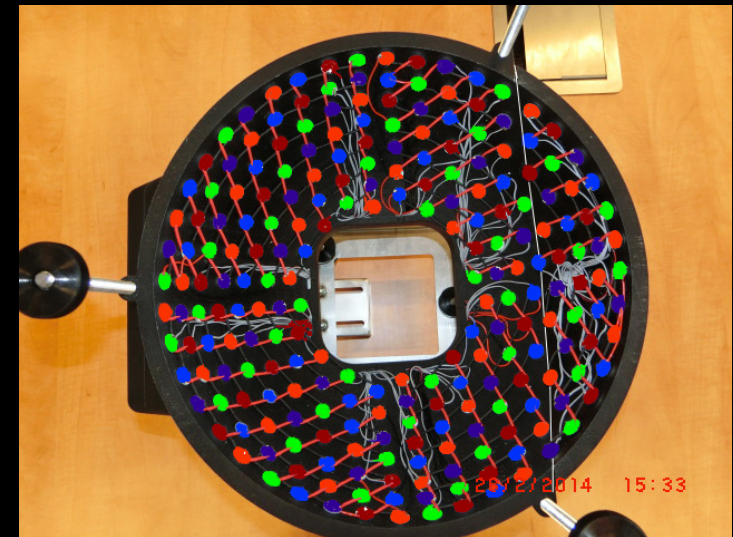
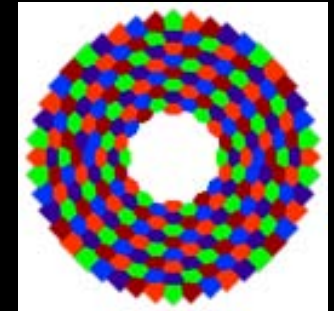
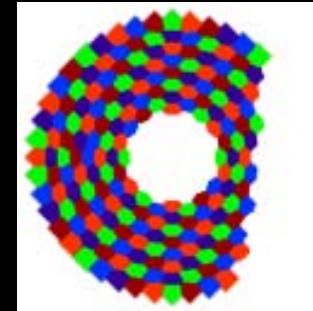
- Smaller dome (30 cm diameter)
- High resolution sensor
- Fixed imaging area (120x180 mm) enabling comparison
- Take of a slice for imaging into the binding
- Transportable
- Fit onto the CCS (also suited for normal photography)
- Fit onto studiostand
- Fit onto tripod
- Stand on a table



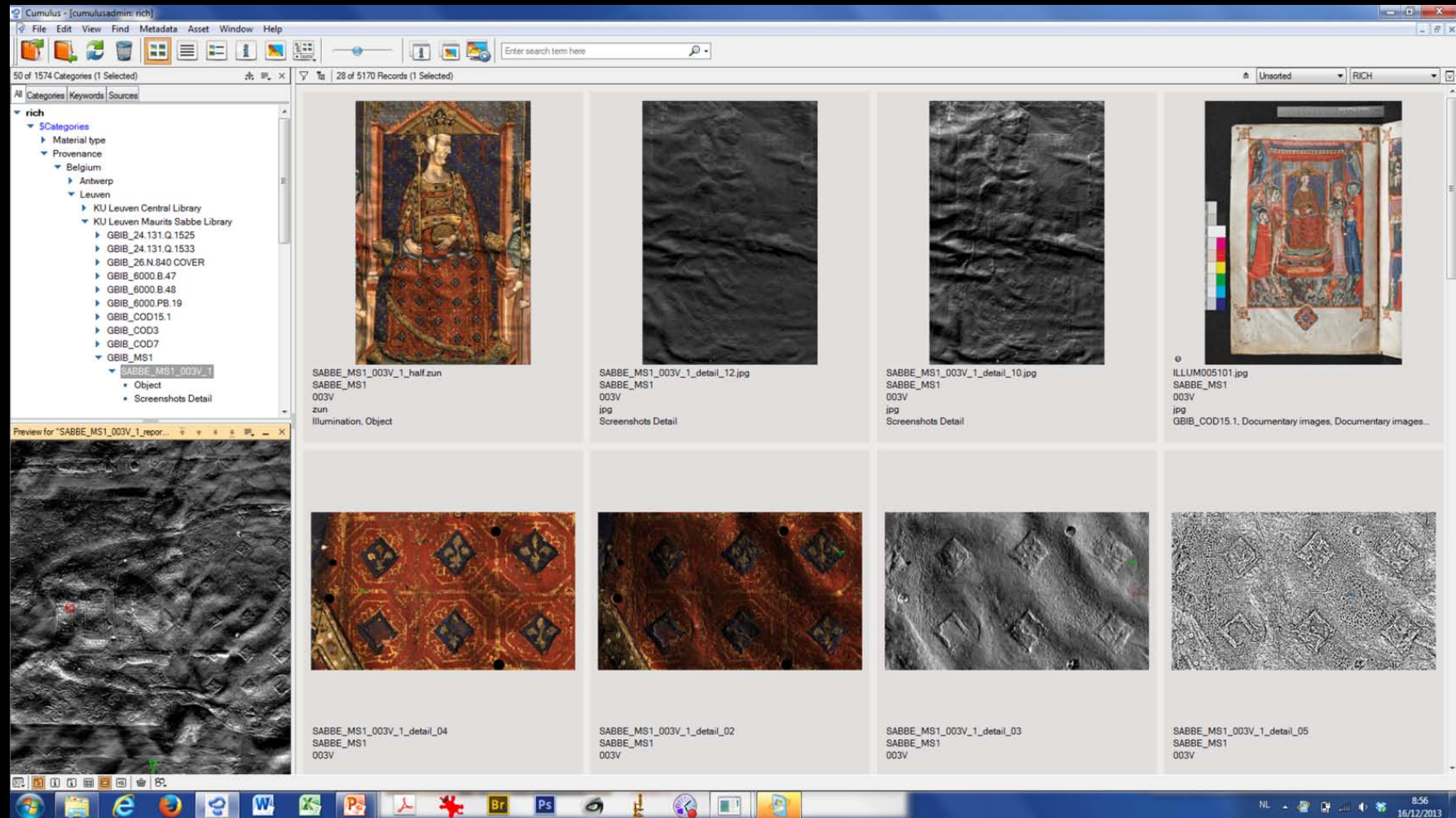


Light

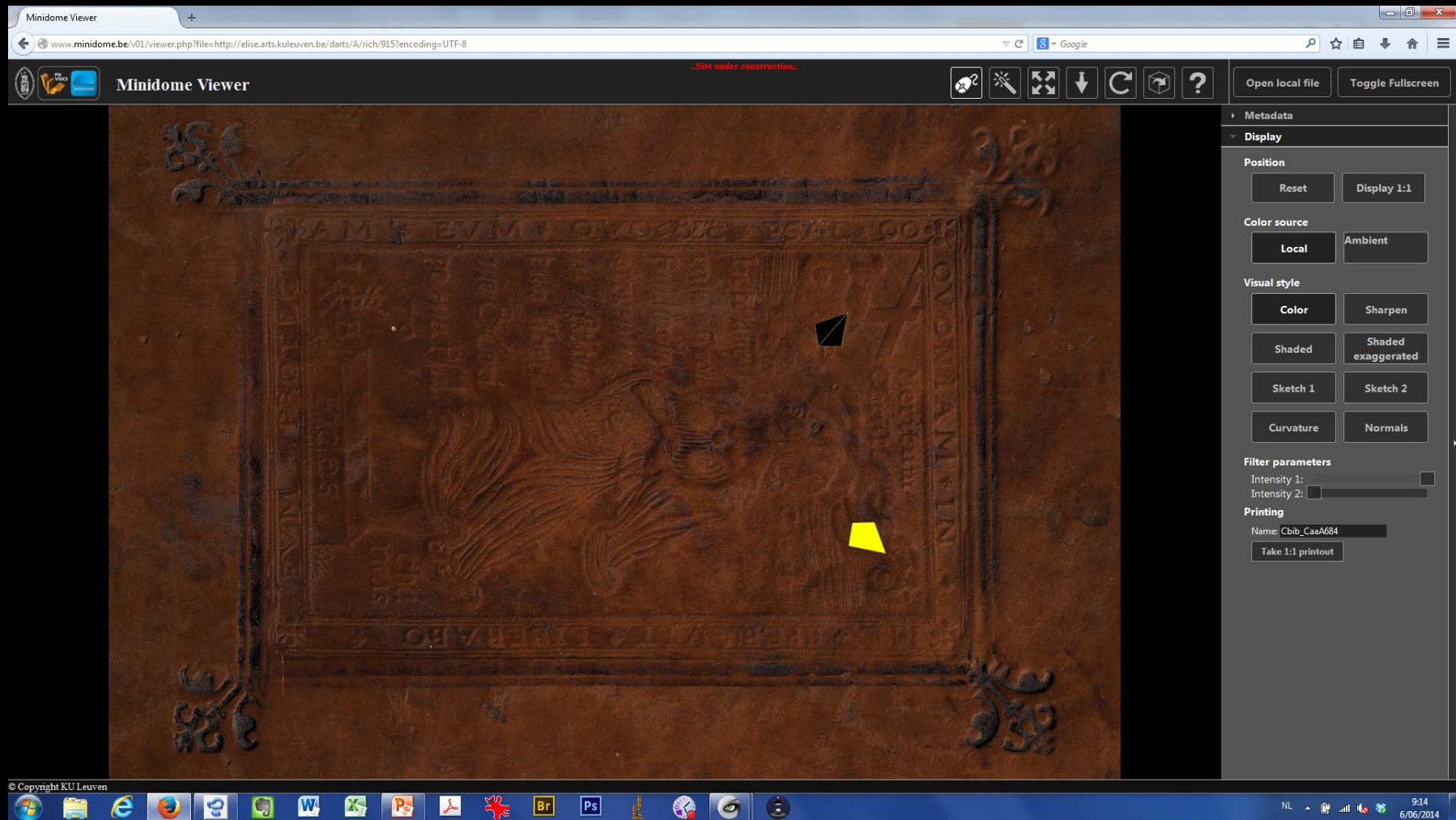
- 1 microdome white light
- 220 LED
- 4000°K
- 1 multi-spectral microdome
- in development
- 220 LED
 - UV: 365 nm
 - BGR: 460 nm, 523 nm, 623nm
 - IR: 850 nm



Dissemination: dARTS database



Dissemination: Webviewer



Art & Conservation Science

Creating measurement & profiles

- Art technical data
 - Defining thickness of paint – ink layers
 - Size of quill and brush strokes
 - Line drawings
- Conservation-Preservation documentation
 - Topography: deformations in the support
 - Damage of surface layers
 - Before and after treatment monitoring

Medieval library artifacts

- Often degraded and damaged: combination of organic & inorganic materials
- Fragile
- Unstable: changes due to environment
- No touch access for scholars
- One file fits all

- Exploring & documenting materiality as an art technical source
- One file can explore multiple research questions
 - Multipels: comparing almost exact copies
 - Topography & measuring tools
 - Comparing before or after treatment - exhibition

Nivelles, City Museum, 'Hortus Conclusus' , *cuir bouilli* panel, crowned and nimbed Madonna and child, surrounded by two Angel musicians and St-George, ca. 1400

Before treatment



After treatment



Nivelles, City Museum, 'Hortus Conclusus' , *cuir bouilli* panel, crowned and nimbed Madonna and child, surrounded by two Angel musicians and St-George, ca. 1400

During treatment



During treatment



Nivelles, City Museum, 'Hortus Conclusus' , *cuir bouilli* panel, crowned and nimbed Madonna and child, surrounded by two Angel musicians and St-George, ca. 1400



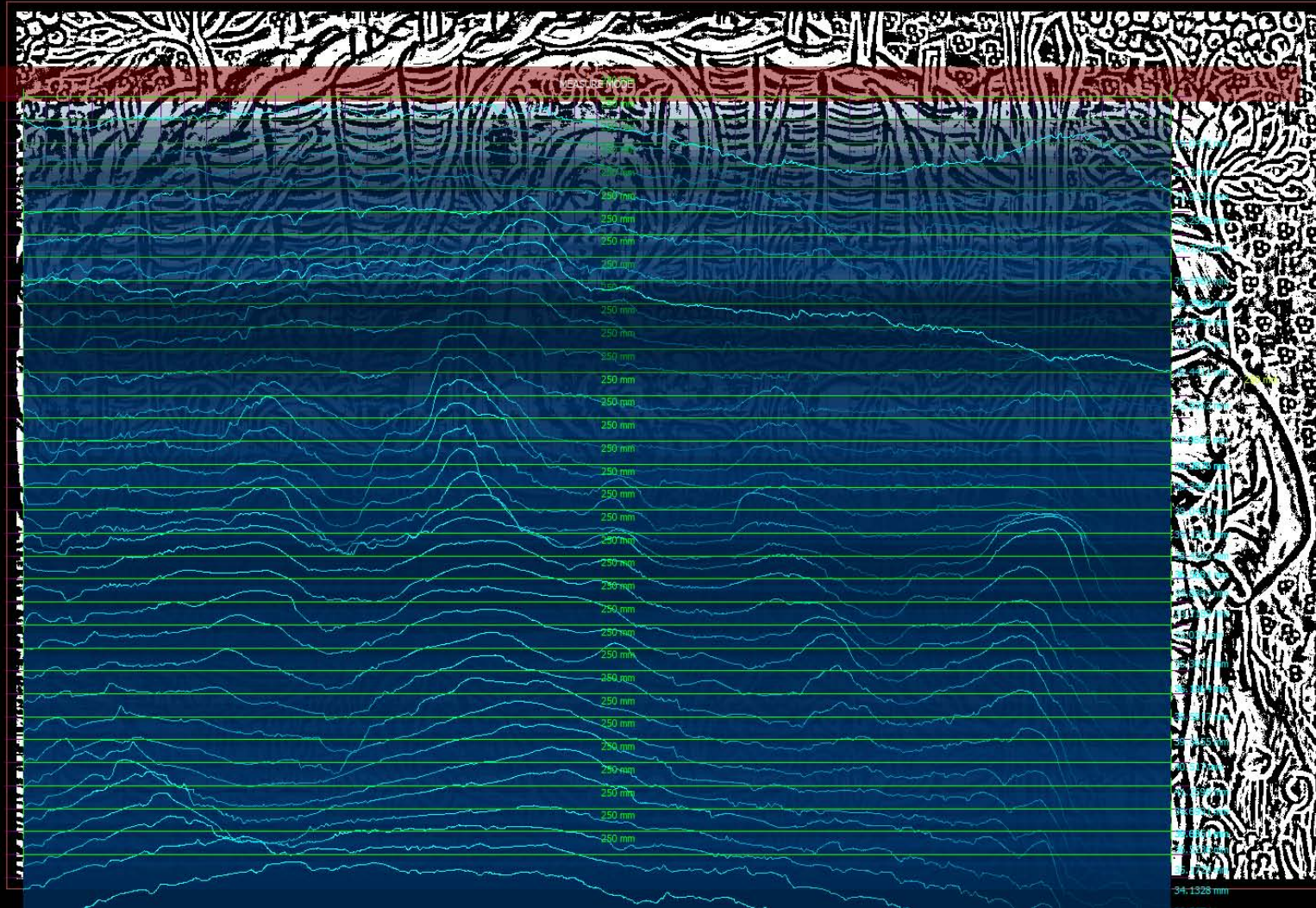
Nivelles, City Museum, 'Hortus Conclusus' , *cuir bouilli* panel, crowned and nimbed Madonna and child, surrounded by two Angel musicians and St-George, ca. 1400

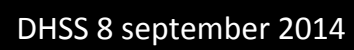


Nivelles, City Museum, 'Hortus Conclusus' , *cuir bouilli* panel, crowned and nimbed Madonna and child, surrounded by two Angel musicians and St-George, ca. 1400



Nivelles, City Museum, 'Hortus Conclusus' , *cuir bouilli* panel, crowned and nimbed Madonna and child, surrounded by two Angel musicians and St-George, ca. 1400







DHSS 8 september 2014



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Leuven, Mauris Sabbe Library, Detail front board,
alum tawned leather over wooden boards, blindtooled,
representation in medaillions of classics (Virgilius, Ovidius..) and reformers (Luther, Hus,
Erasmus)



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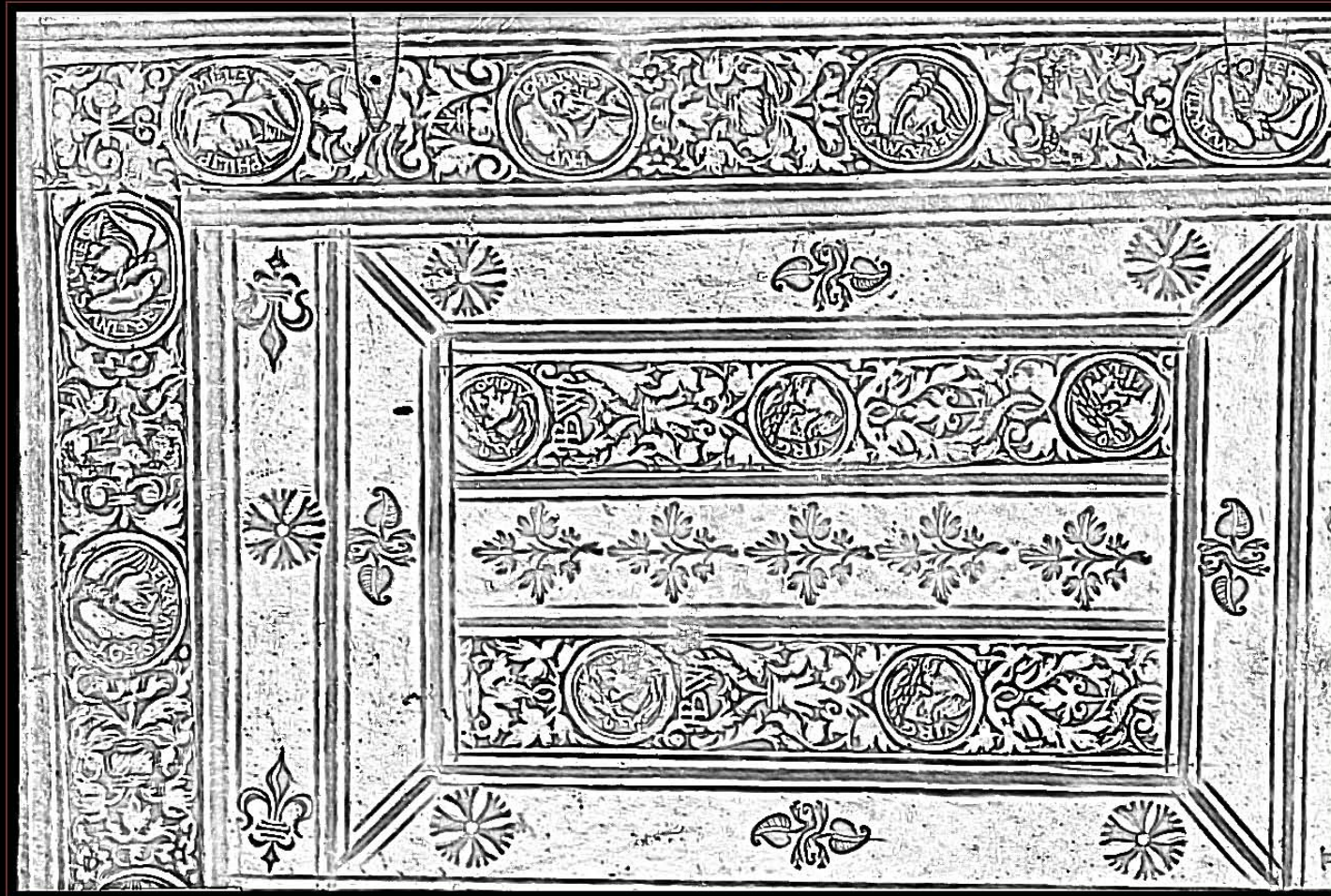
Leuven, Mauris Sabbe Library, Detail front board,
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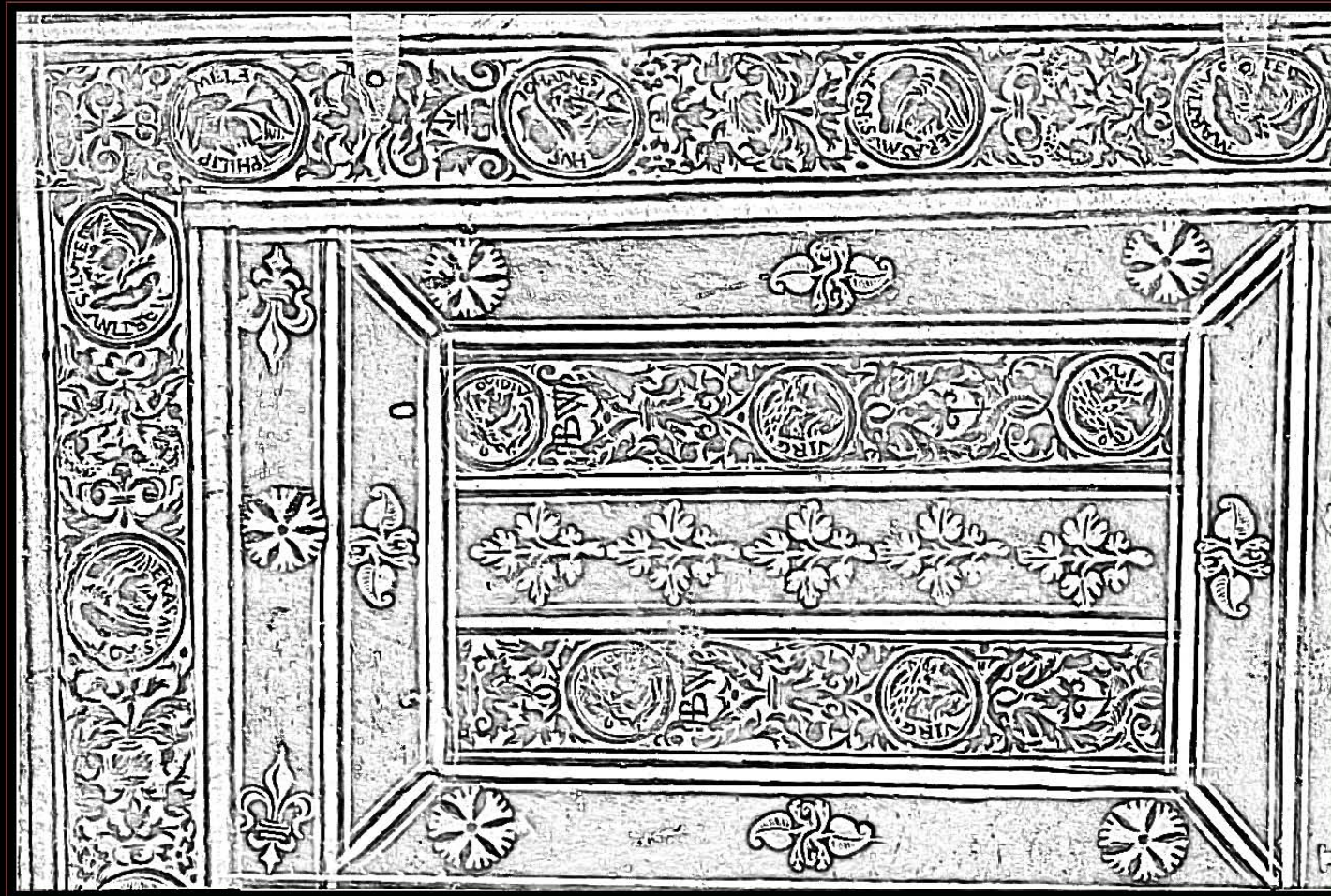
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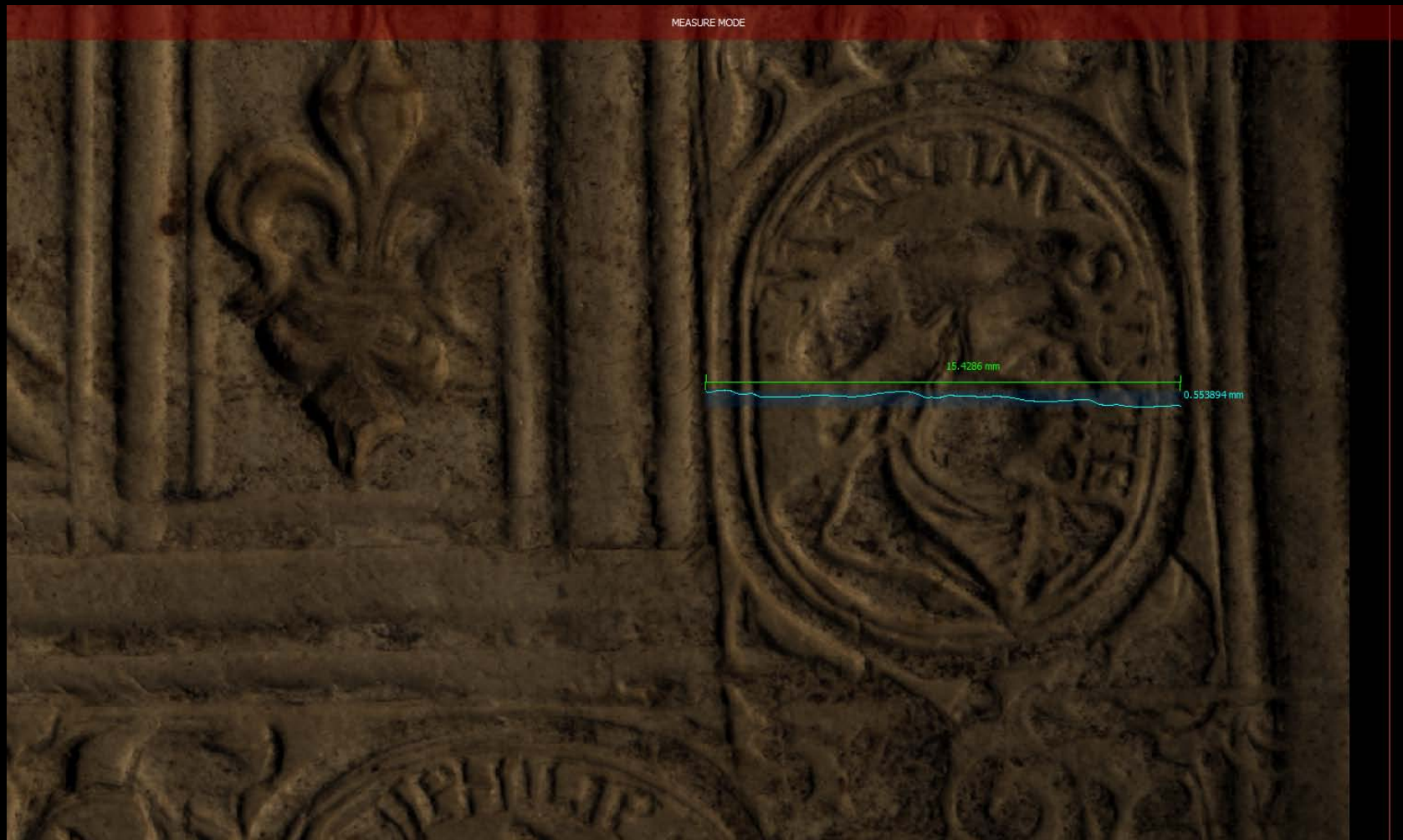
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Antiphonary , early 14th century, tempera on parchment , folio 28, Joseph addressing kneeling Jews, third Sunday in Lent, 'Videntes Ioseph a longe loquebantur'



Ghent Fransiscan Antiphonary

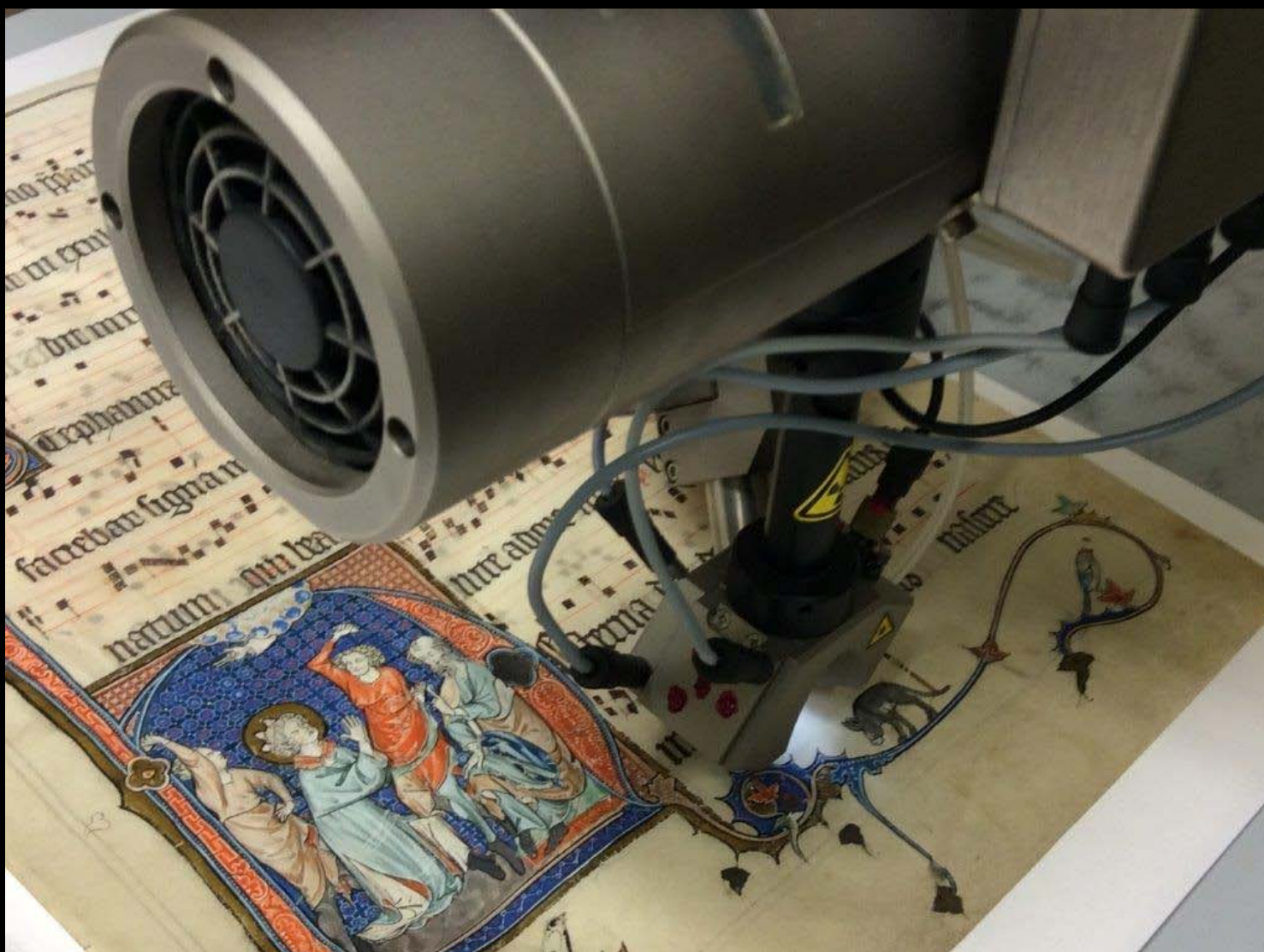


Ghent Fransiscan Antiphonary

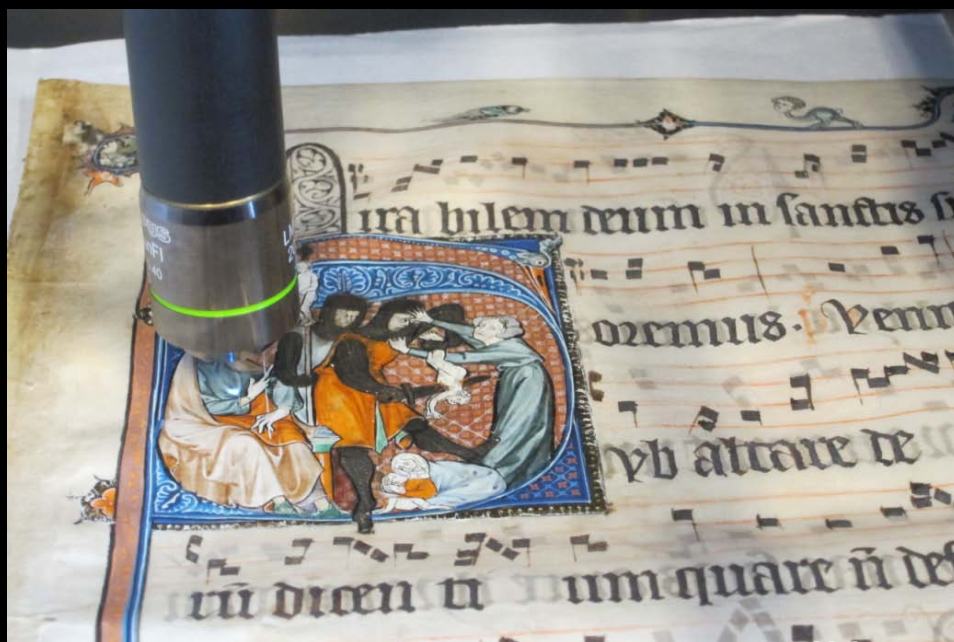


Gent Fransiscan Antiphonary

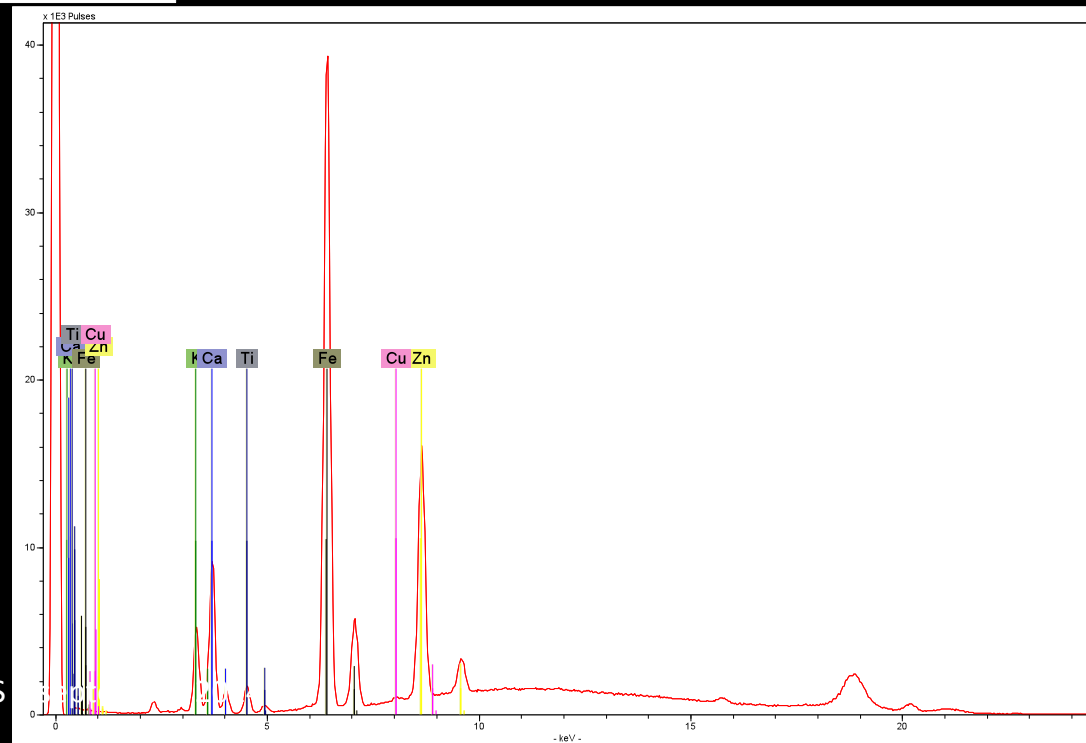
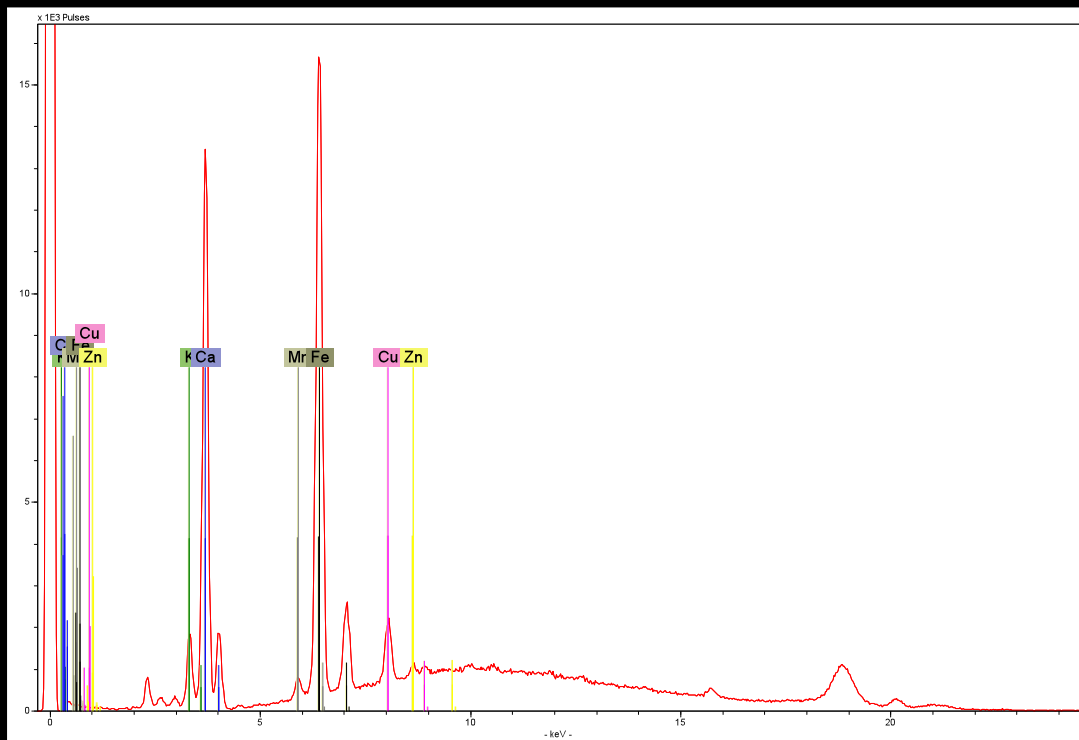




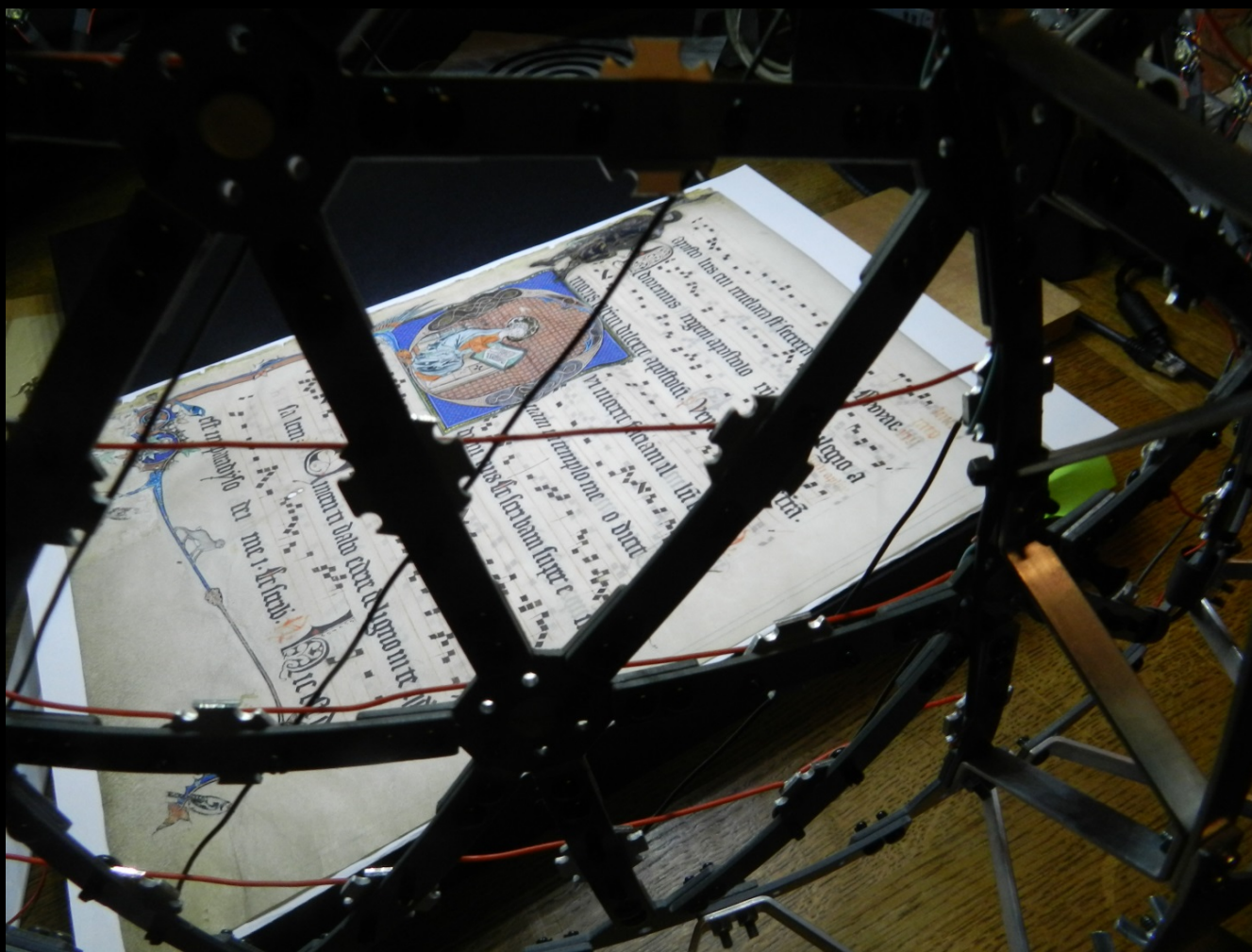
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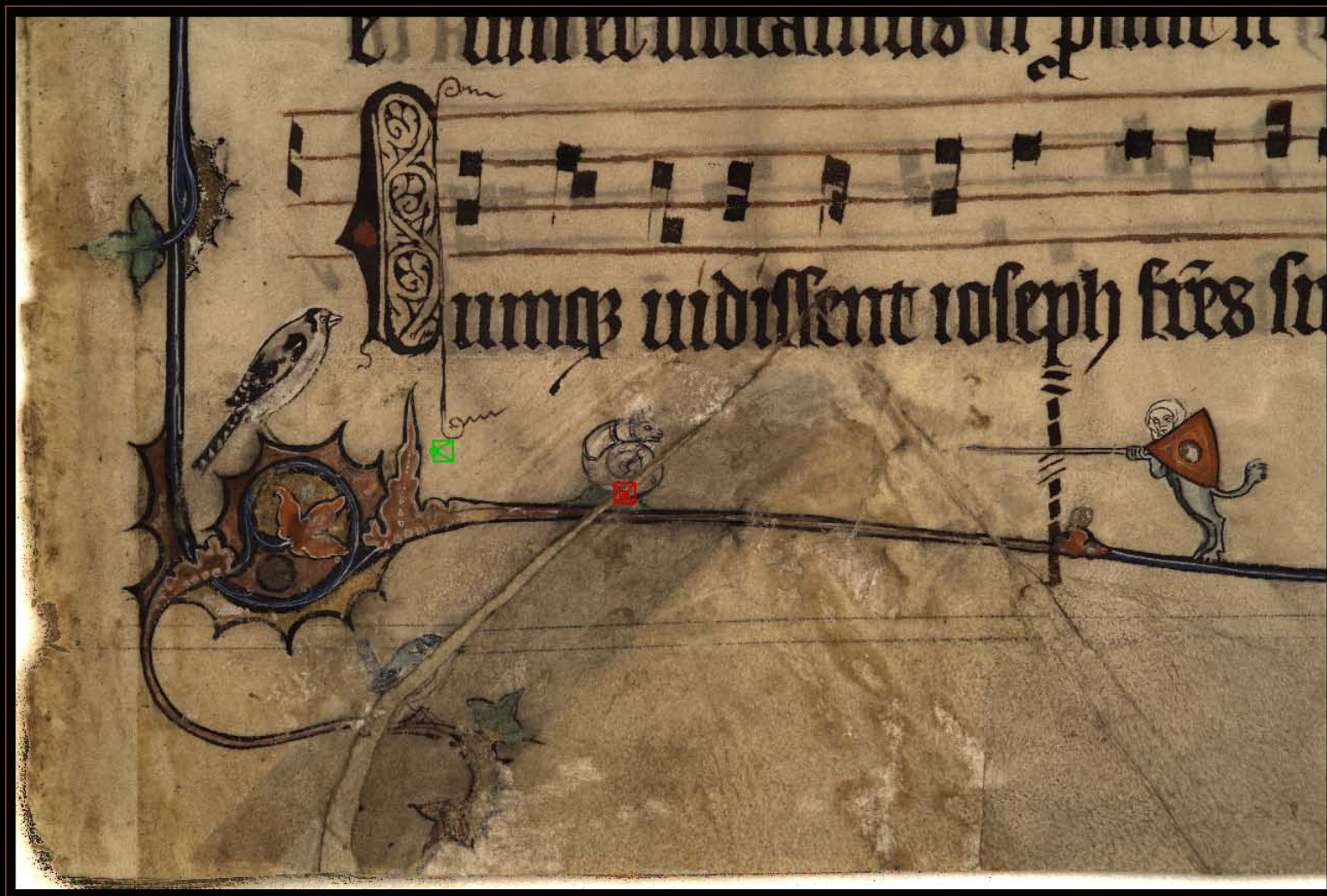


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Folio 28v

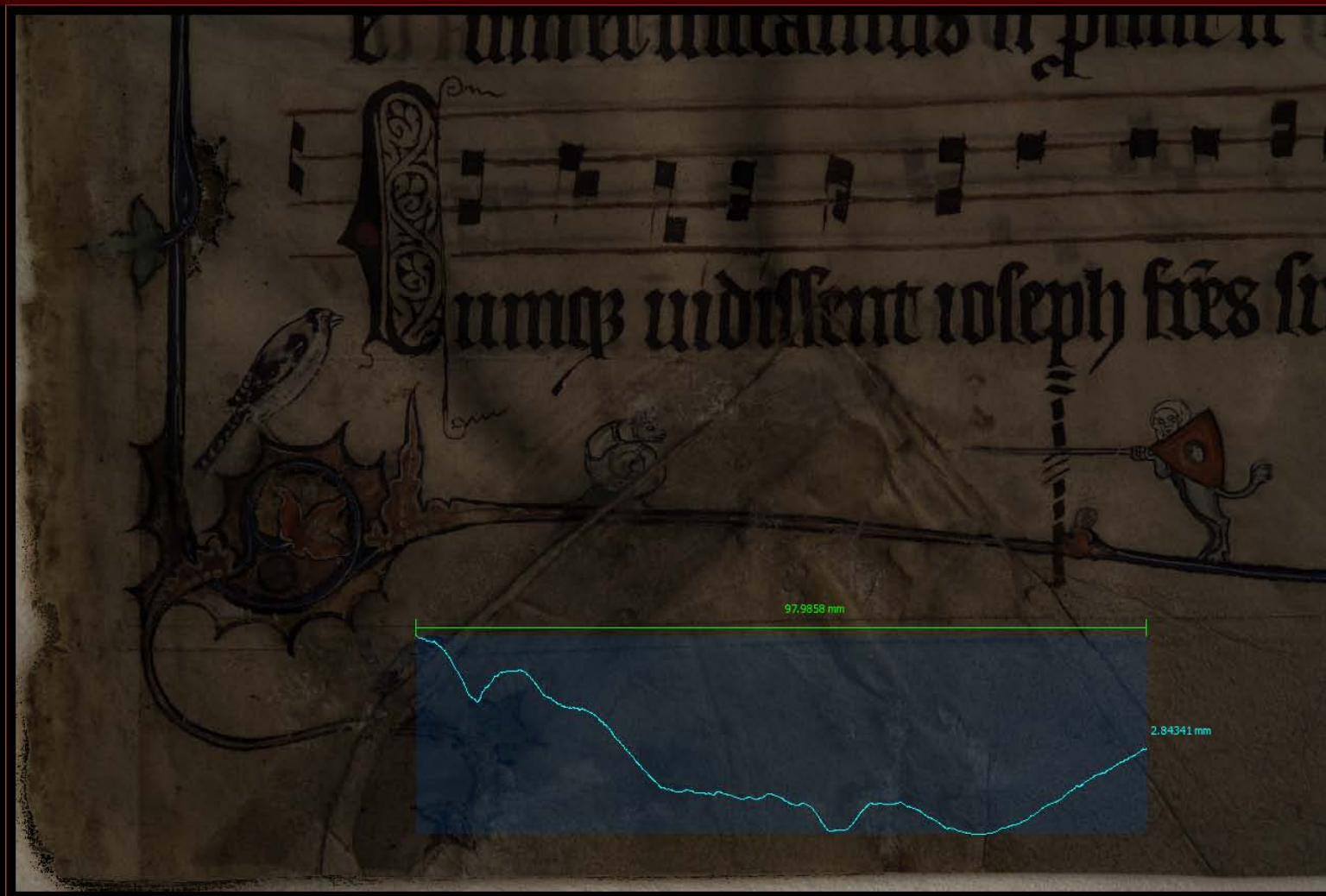






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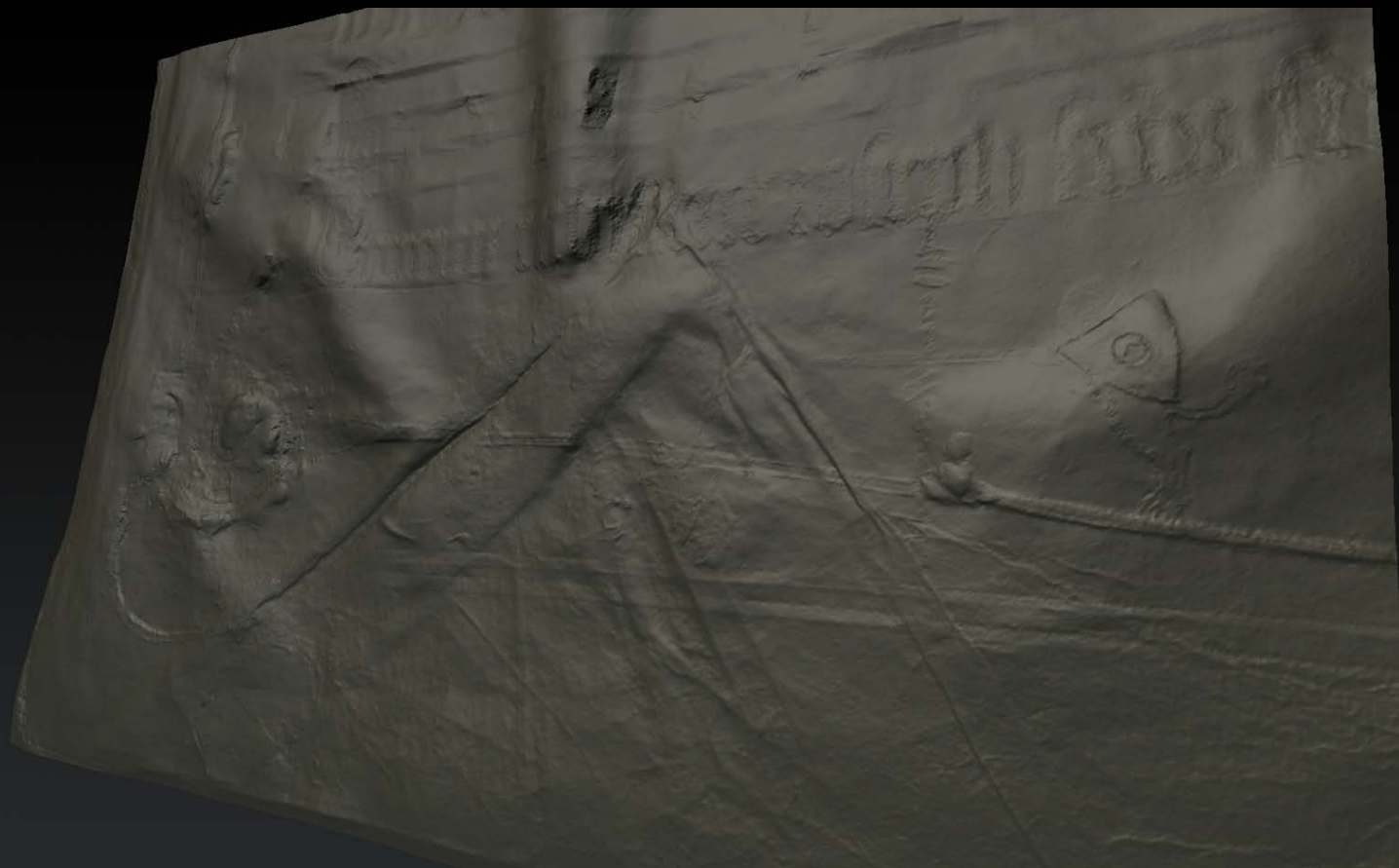
Folio 28v







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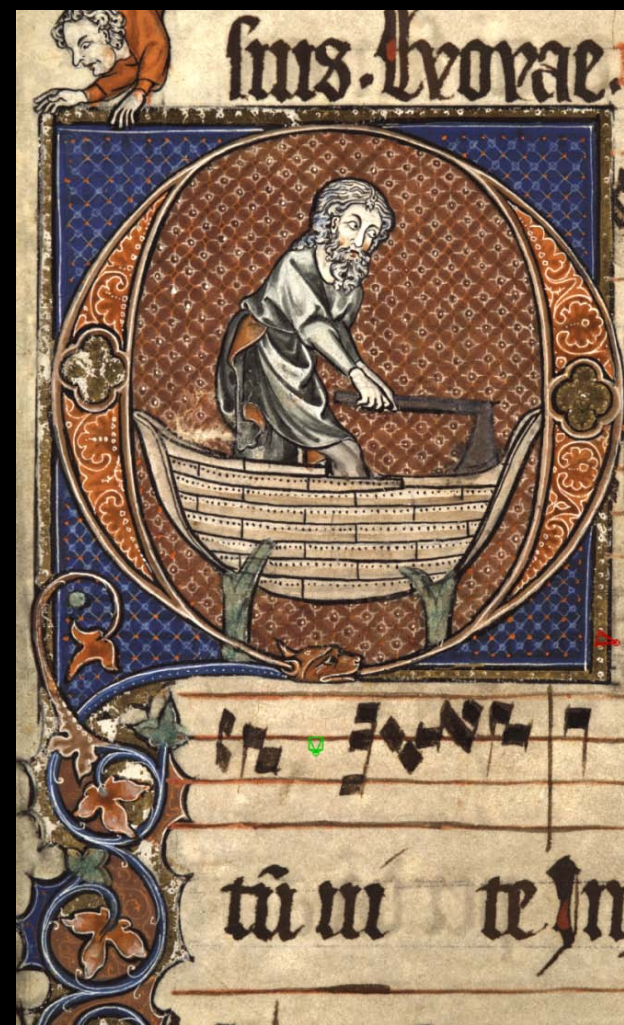
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Antiphonary , early 14th century, tempera on parchment , folio 4r, Noah building his Ark, first Saturday in Advent, 'Quadragesima dies et noctes aperti sunt'



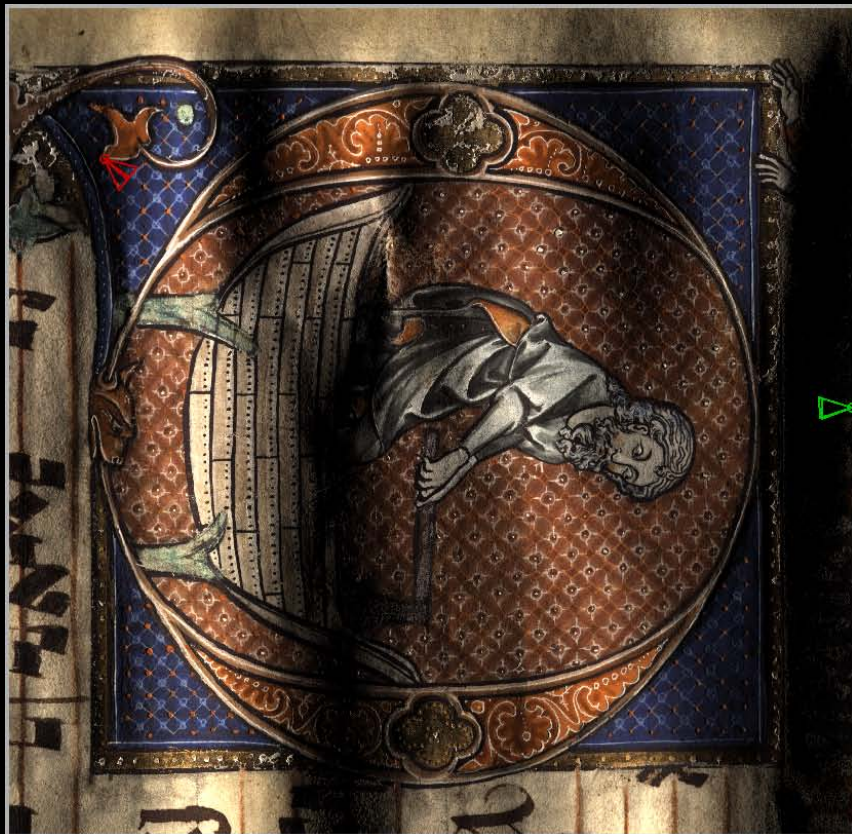
Comparison treated-untreated

Folio 4R



Comparison treated-untreated

Folio 4R

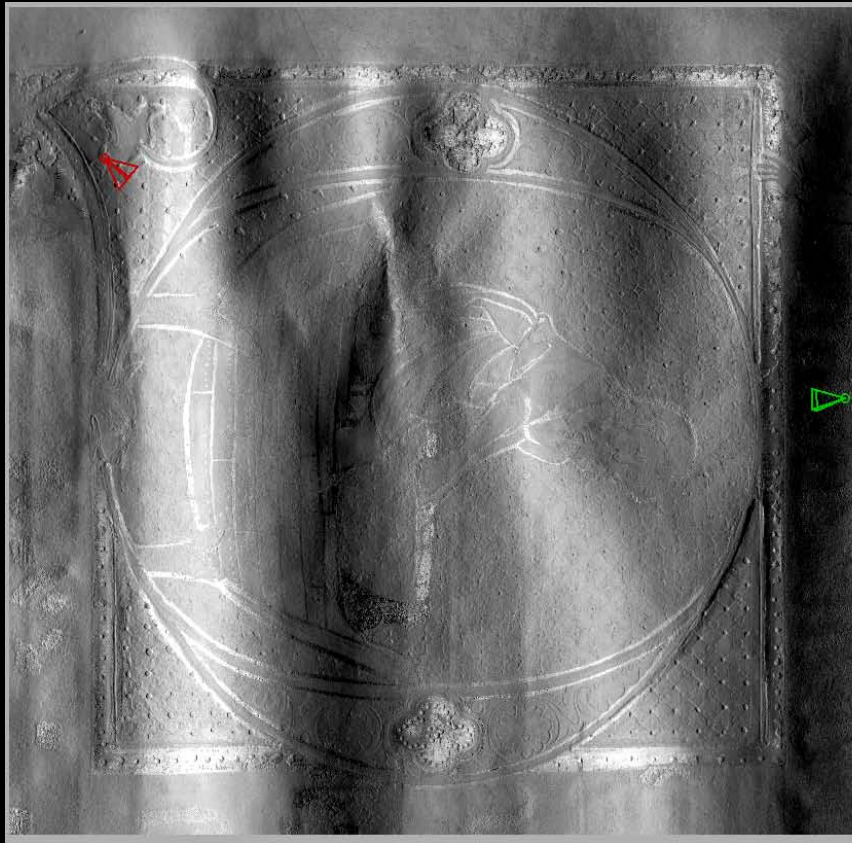


untreated

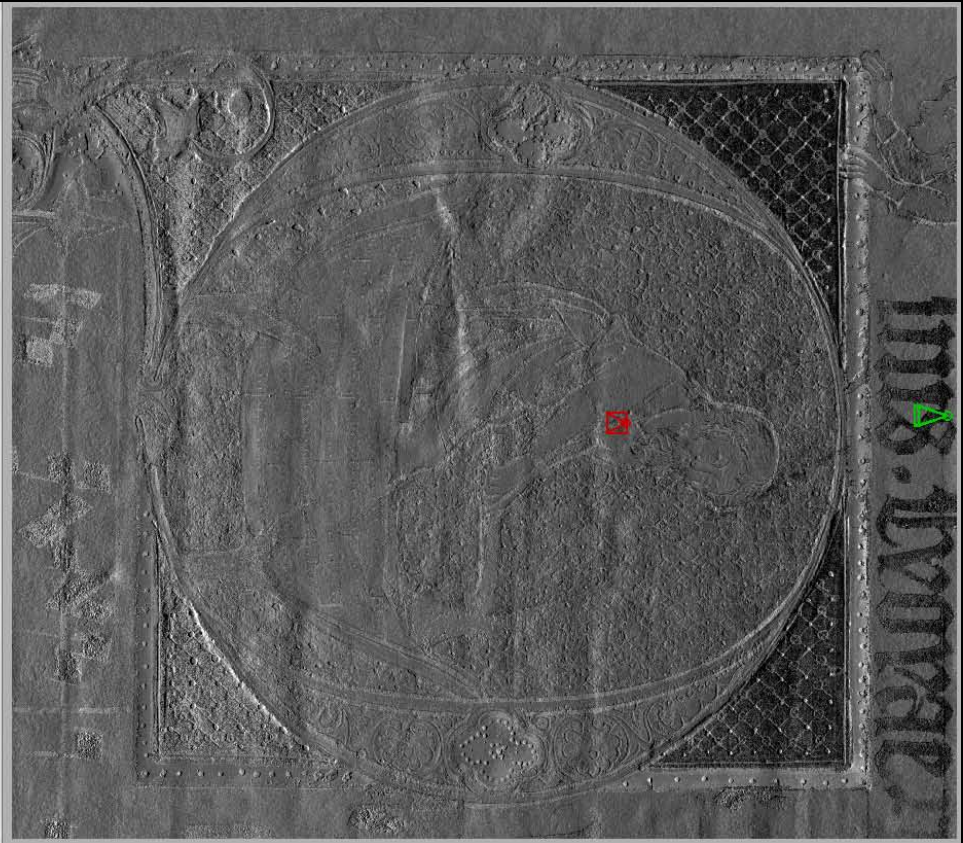


treated

Shaded filter

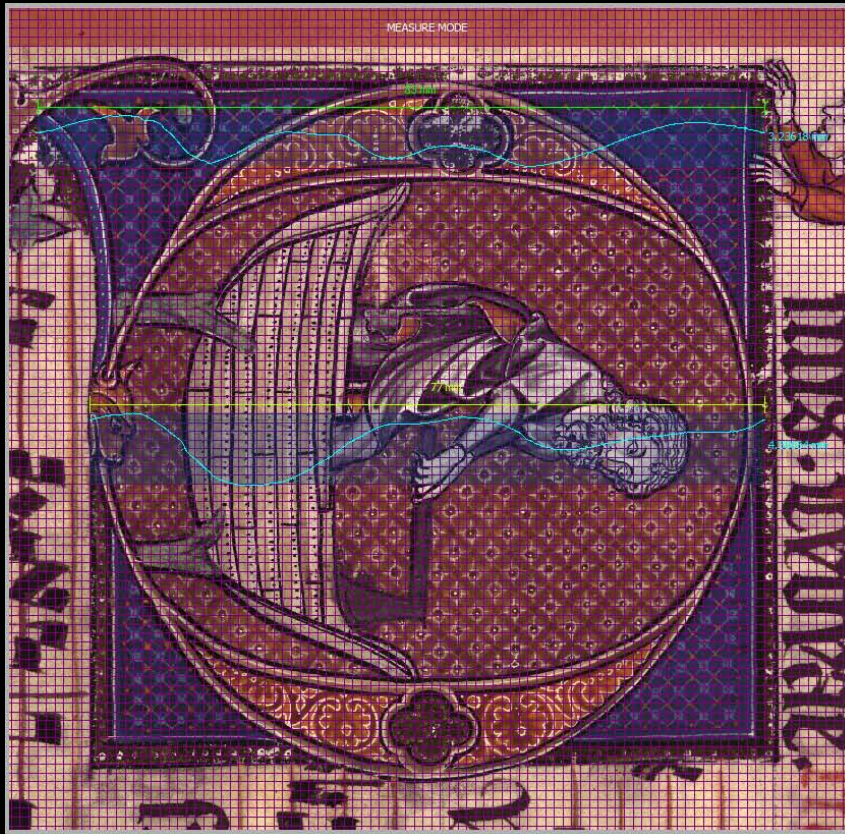


untreated

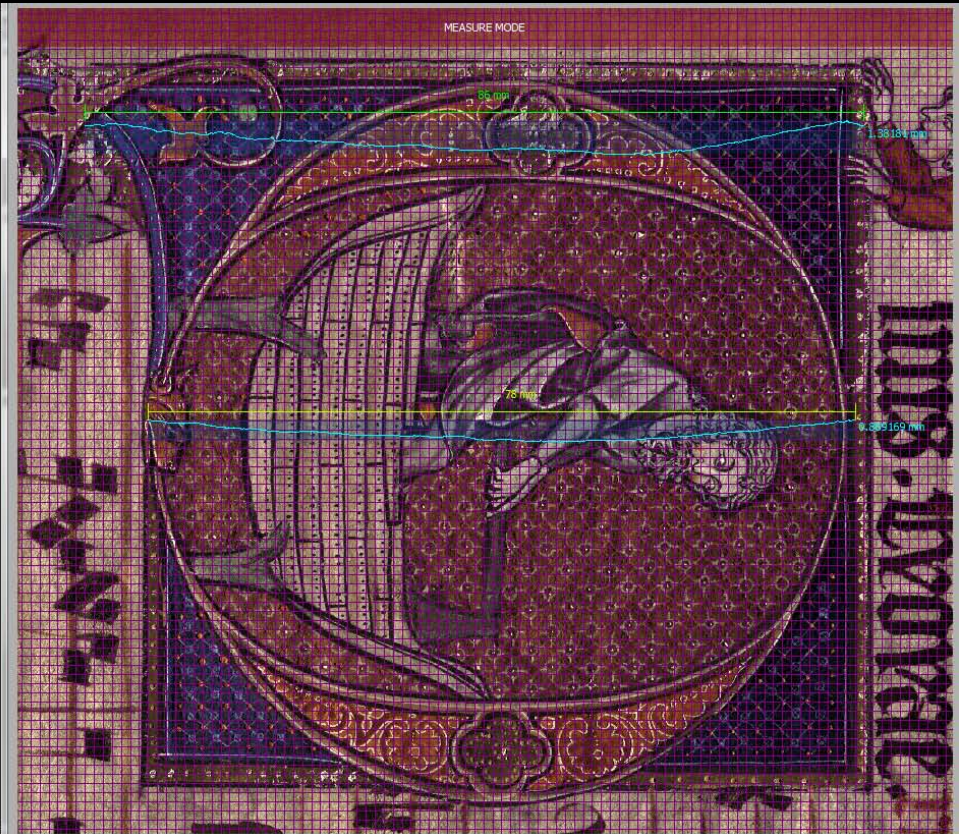


treated

Measurements & profiles

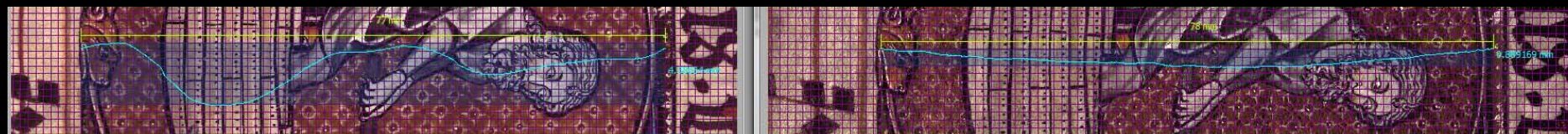


untreated



treated

Comparison heightprofile



1

0

0

10

20

30

40

50

60

70

80

90

-1

-2

-3

-4

-5

Folio 34R

Folio 34R Treated

Comparison treated-untreated

Folio 12R

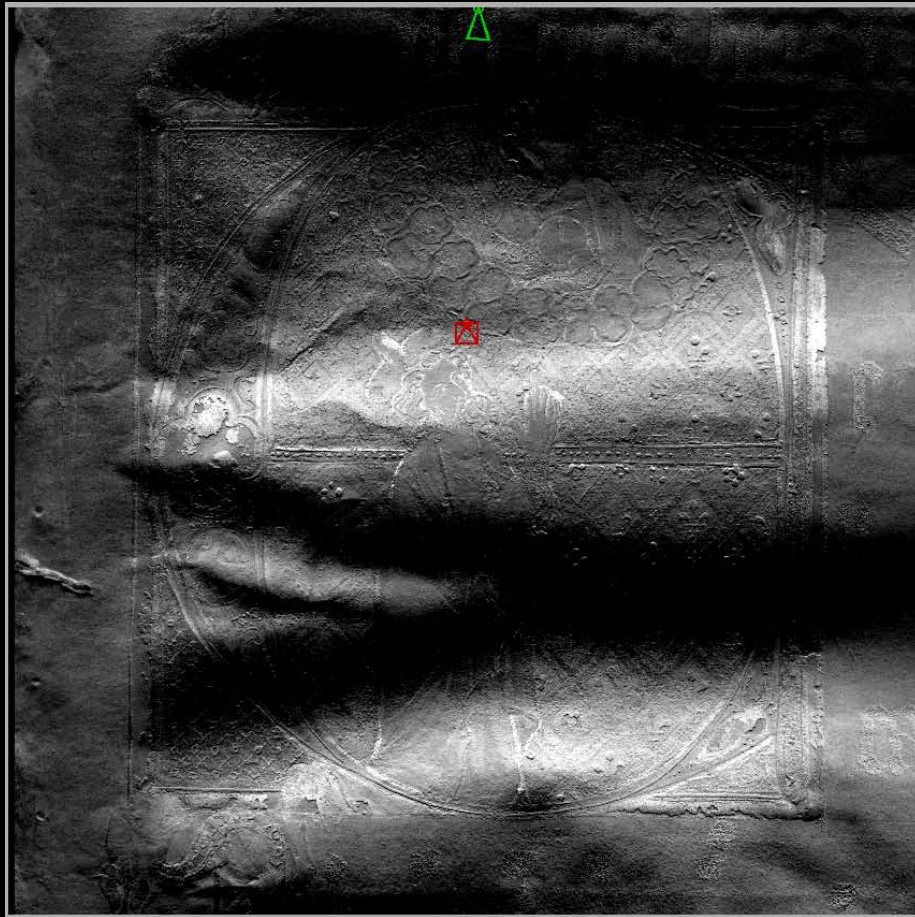


untreated

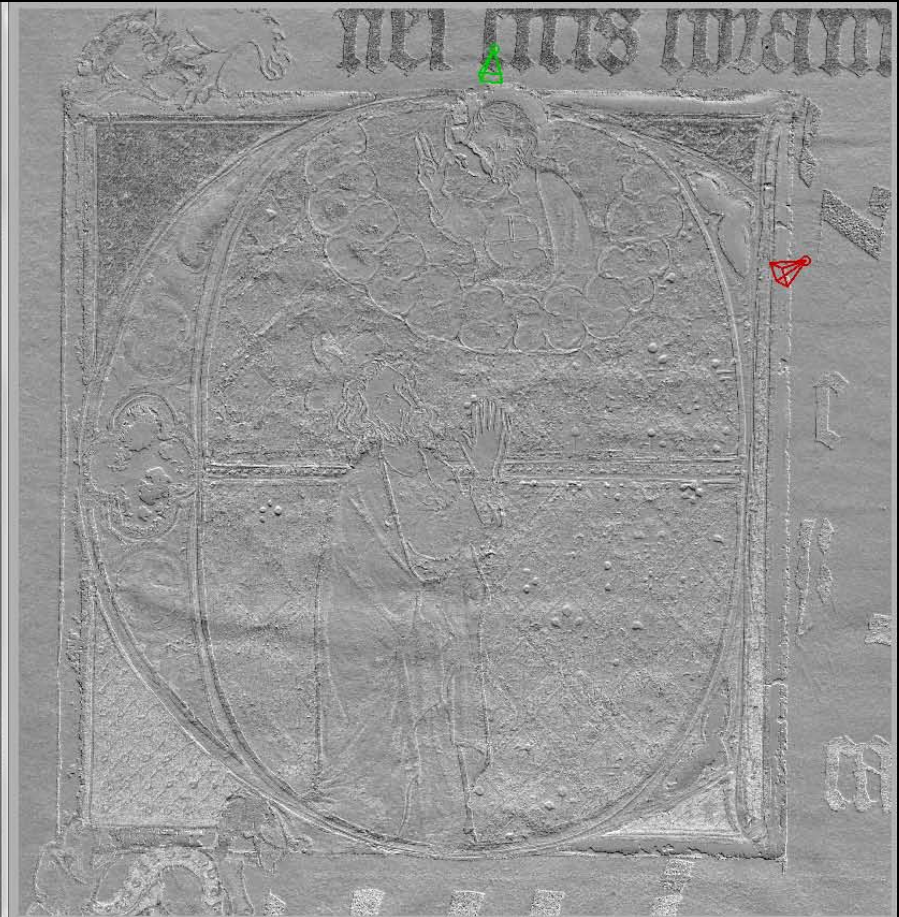


treated

Shaded filter



untreated

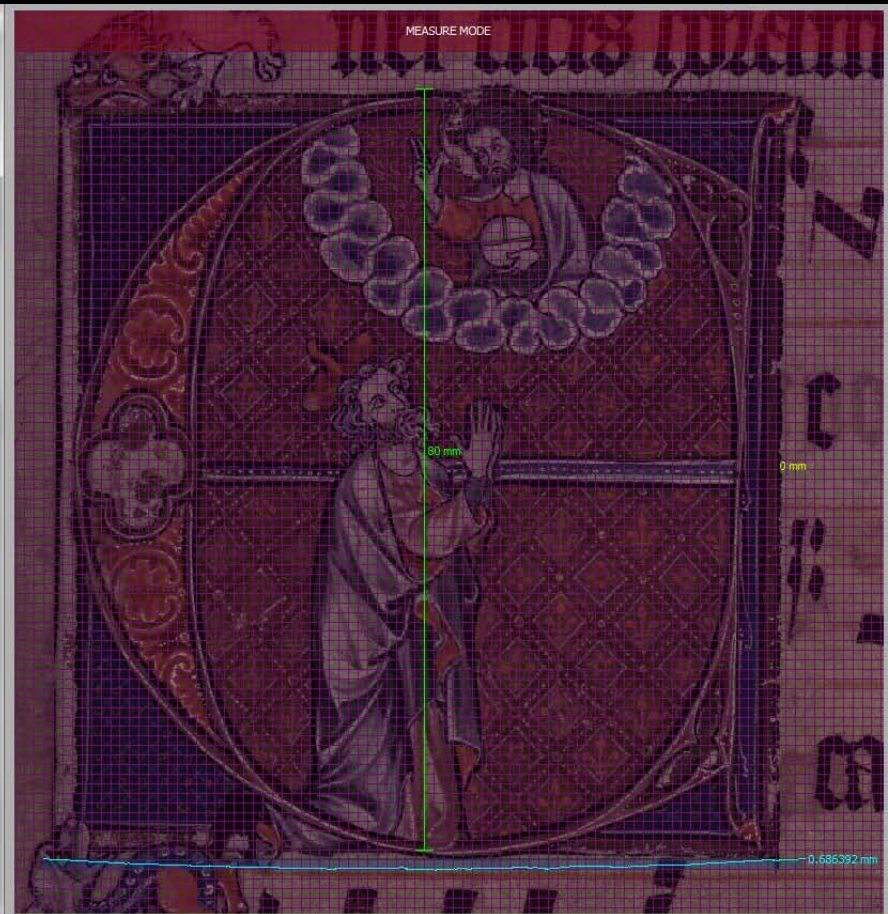


treated

Measurements & profiles

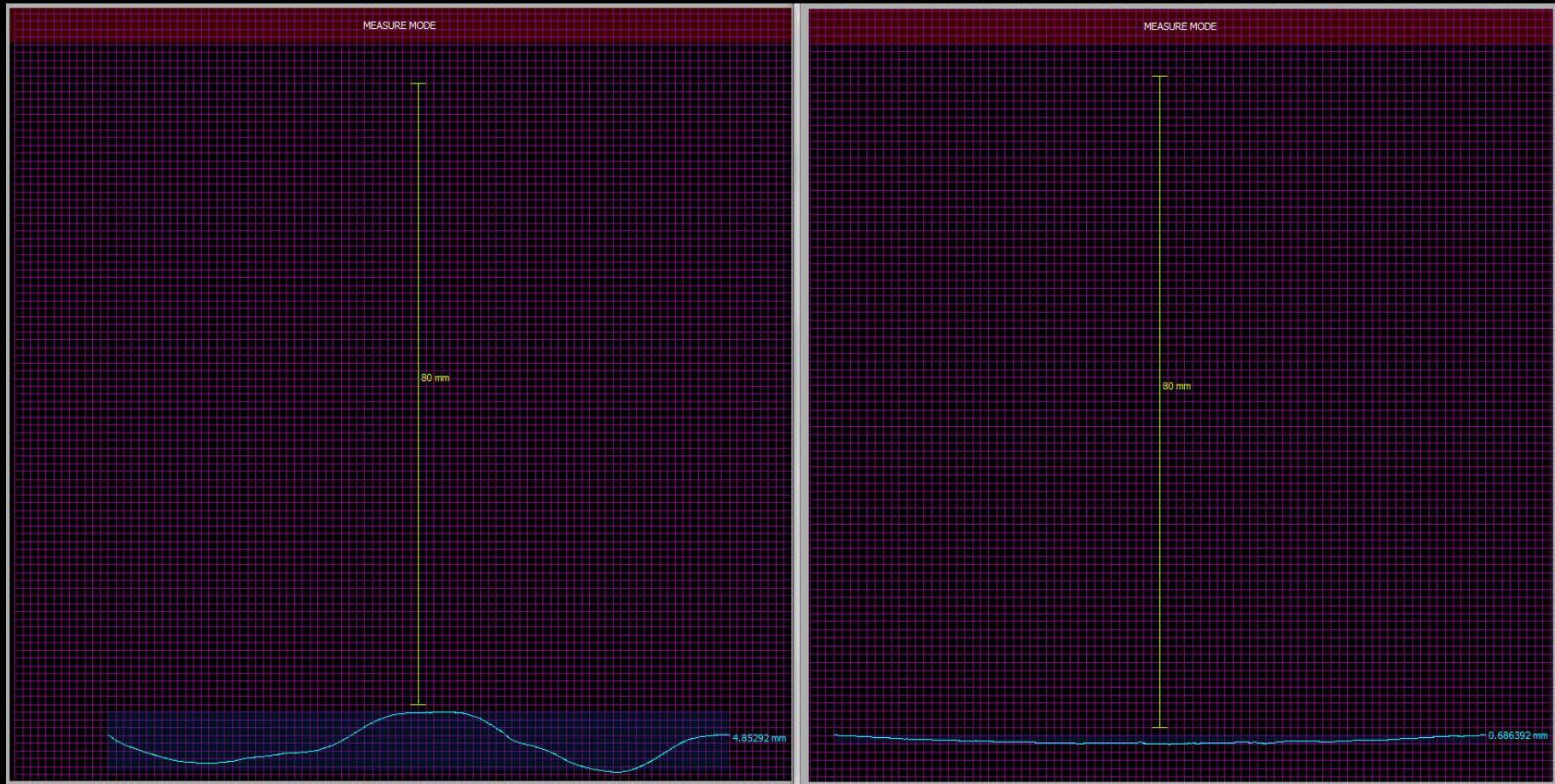


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treated

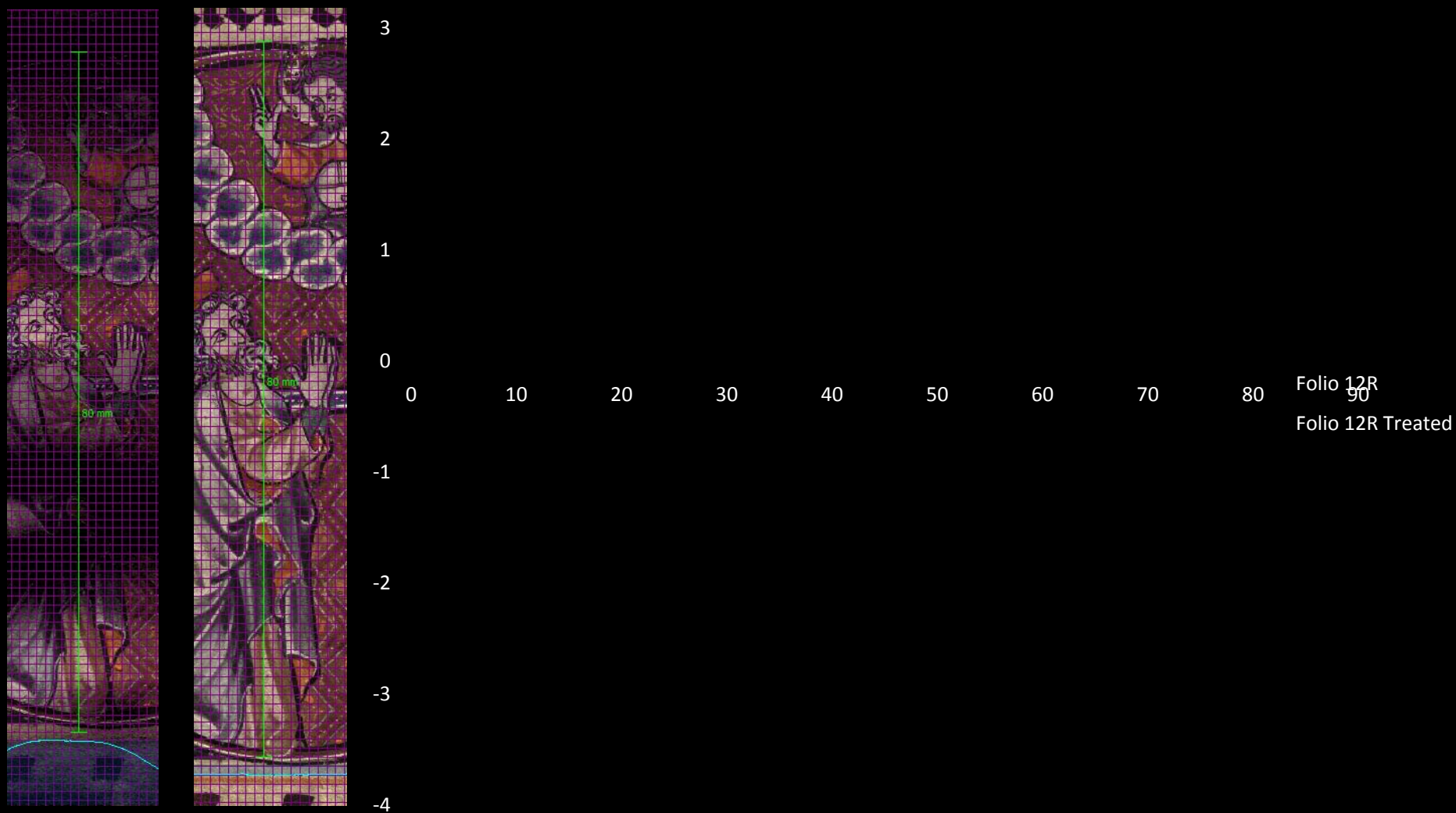
Measurements & profiles



untreated

treated

Comparison heightprofile



KU Leuven, University Archive, Charter, 16th century, Seals, Lead, Peter & Paul

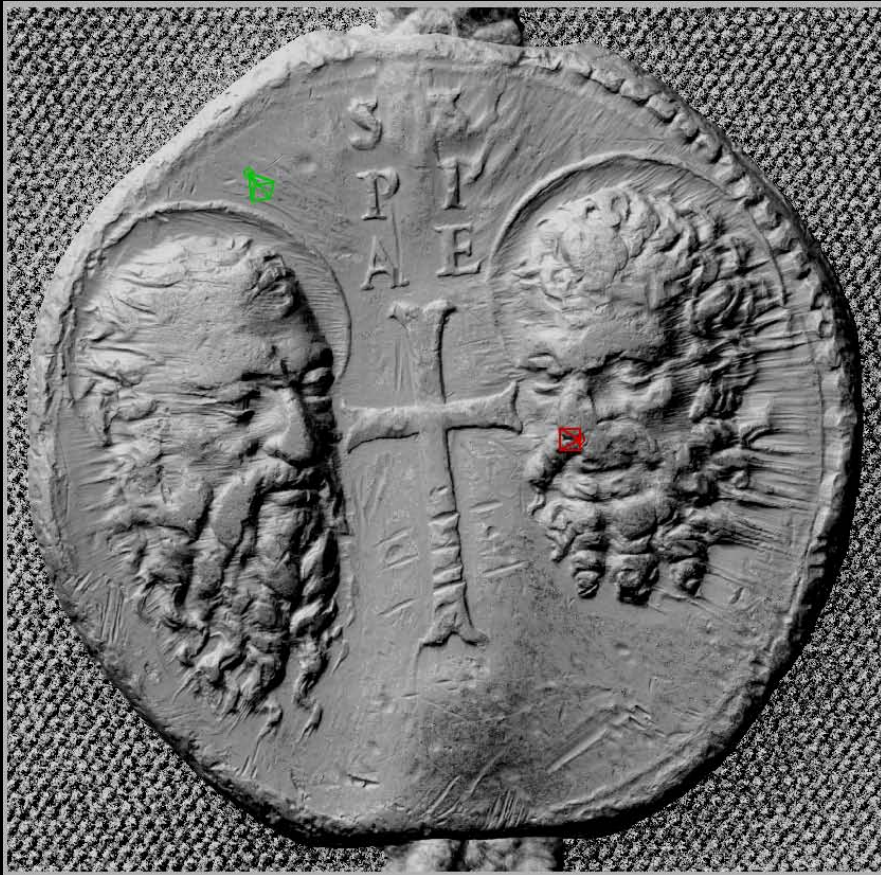


Seal 76

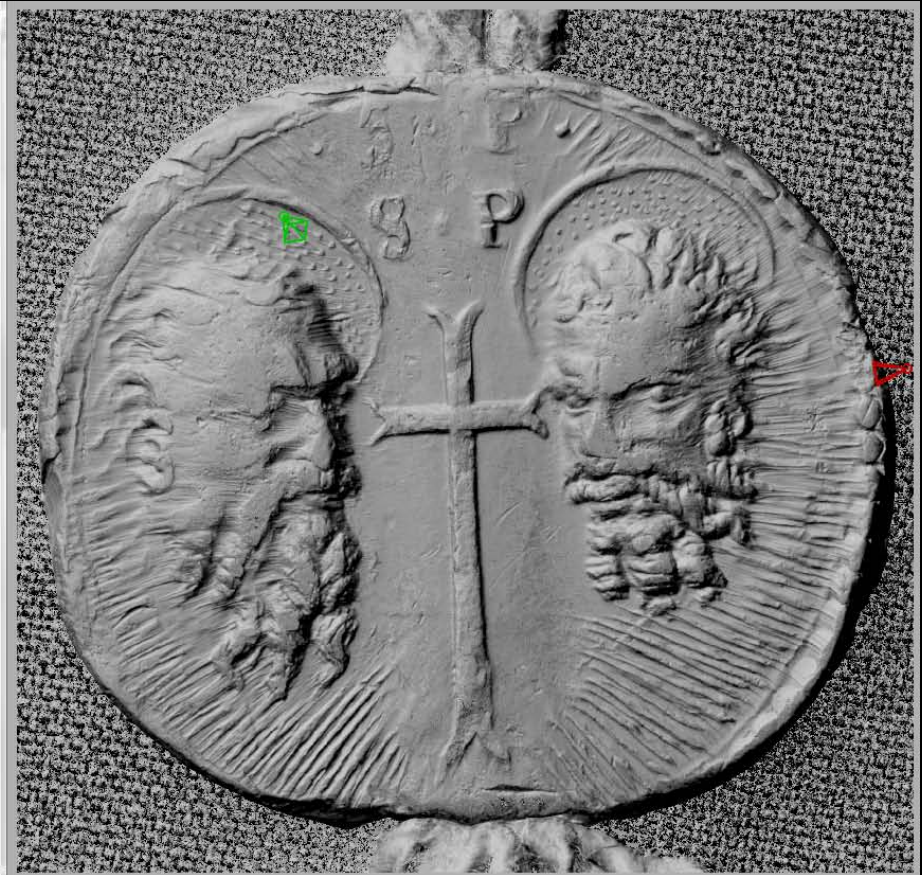


Seal 32

KU Leuven, University Archive, Charter, 16th century, Seals,
Lead, Peter & Paul, Shading filter



Seal 76

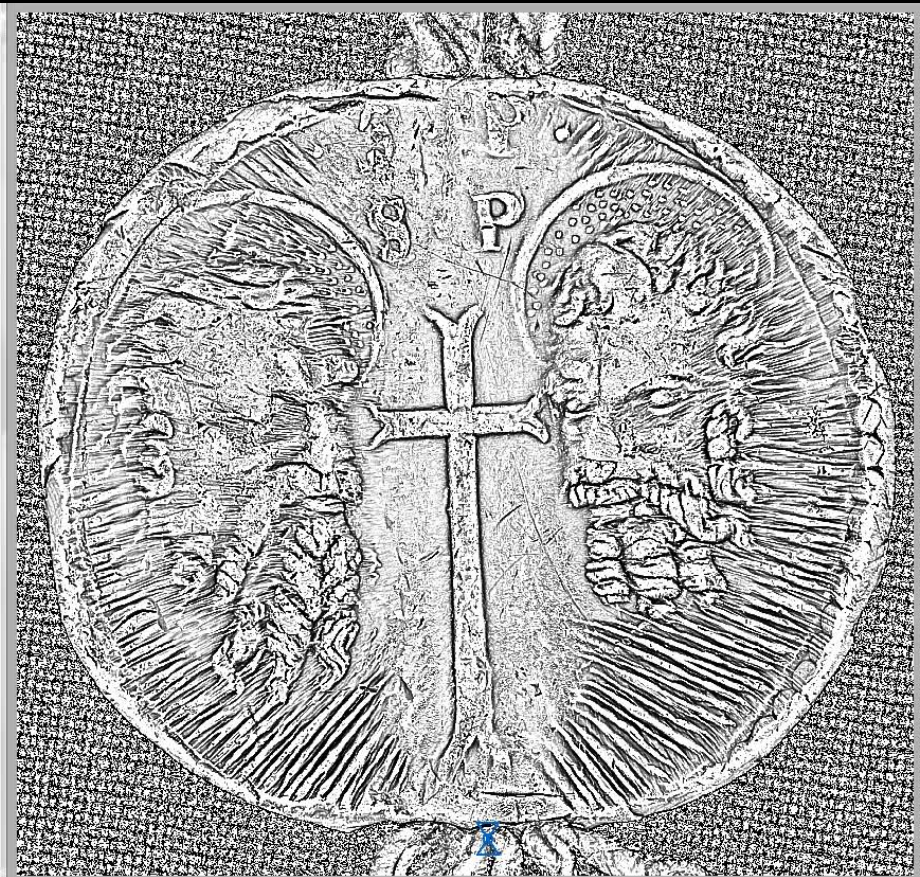


Seal 32

KU Leuven, University Archive, Charter, 16th century, Seals,
Lead, Peter & Paul, Line drawing



Seal 76



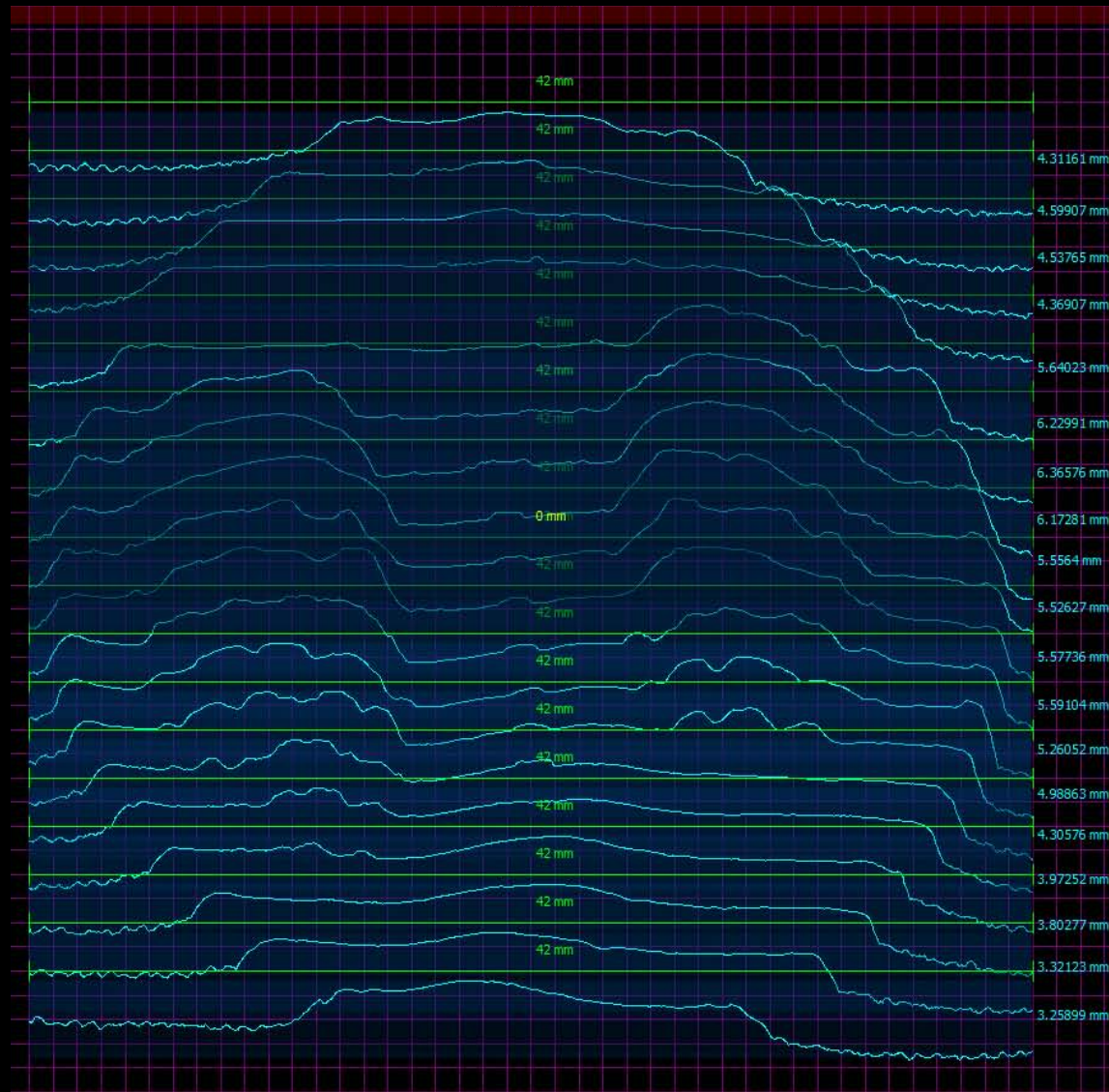
Seal 32

KU Leuven, University Archive, Charter, 16th century, Seal 76, Peter & Paul



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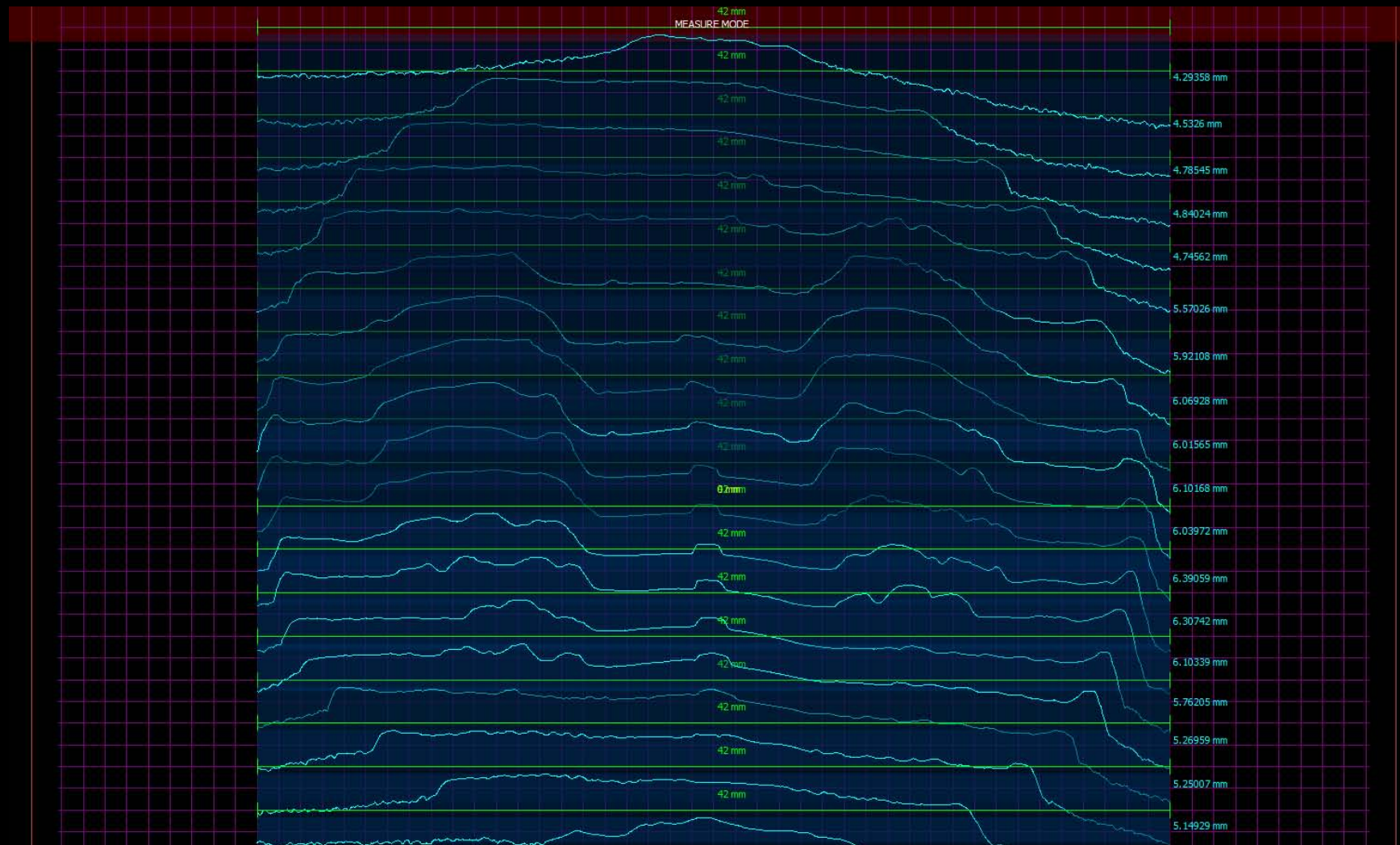
KU Leuven, University Archive, Charter, 16th century, Seal 76, Peter & Paul



KU Leuven, University Archive, Charter, 18th century, Seal 32, Peter & Paul



KU Leuven, University Archive, Charter, 18th century, Seal 32, Peter & Paul



RICH Project – KU Leuven – Belgium

Team

Faculty of Arts & Humanities & Illuminare:

Lieve Watteeuw, Bruno Vandermeulen, Jan Van der Stock

Illuminare, Research Centre for Medieval Art: Jan Van der Stock; ESAT: Luc Van Gool

CS/Digital: Fred Truyen; University Library: Stefan Gradman

Partner: Museum Plantin-Moretus, Antwerp (Unesco World Heritage)

Involved in the Portable Light Dome projects and development

Hendrik Hameeuw, Paul Konijn, Marc Proesmans, David Tingdahl, Bruno Vandermeulen, Jan Van der Stock, Luc Van Gool, Karel Van Lerberghe, Vincent Vanweddingen, Frank Verbiest, Gabriella Voet, Geert Willems

Blog: portablelightdome.wordpress.com

Contact RICH: lieve.watteeuw@arts.kuleuven.be



Reflectance Imaging for Cultural Heritage



VISICS

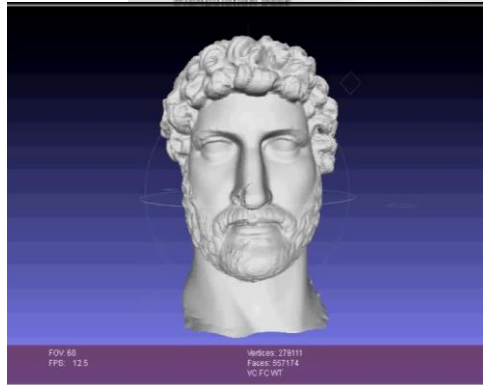
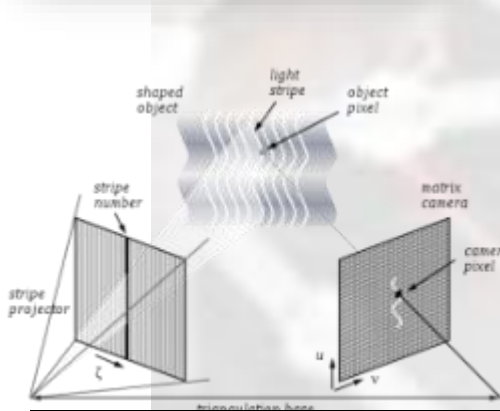
Marc Proesmans

KULeuven's Computer Vision group

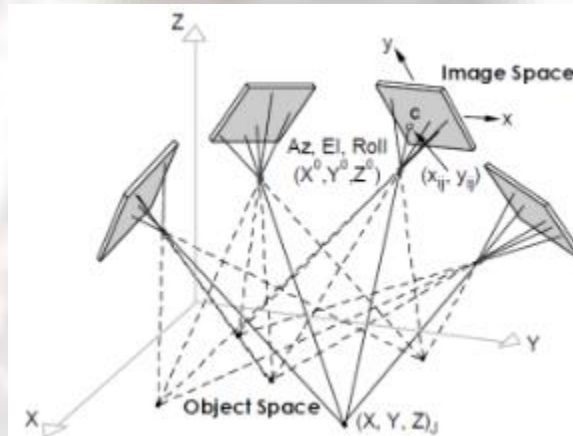
**2D image analysis, segmentation, recognition,
3D reconstruction, scanning, visualization**

Reflectance Imaging for Cultural Heritage

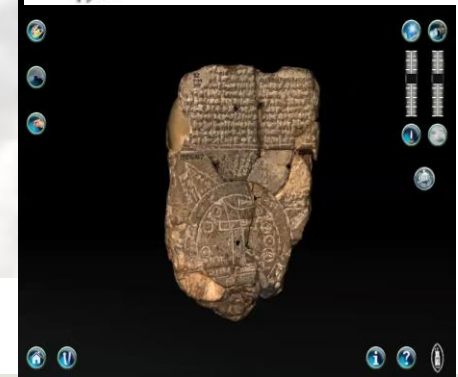
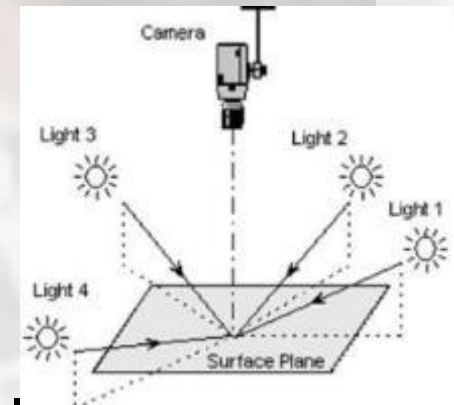
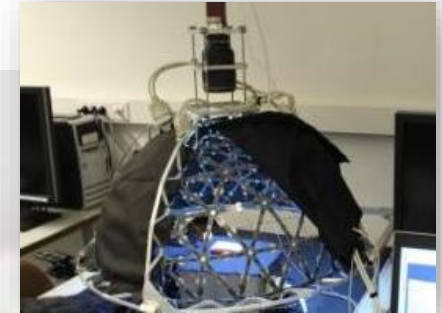
Structured light / laser



Photogrammetry



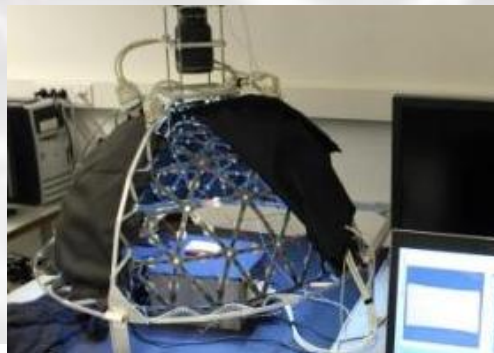
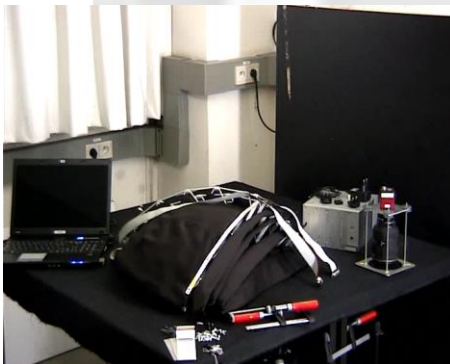
Photometric stereo



Reflectance Imaging for Cultural Heritage

Photometric stereo using light domes

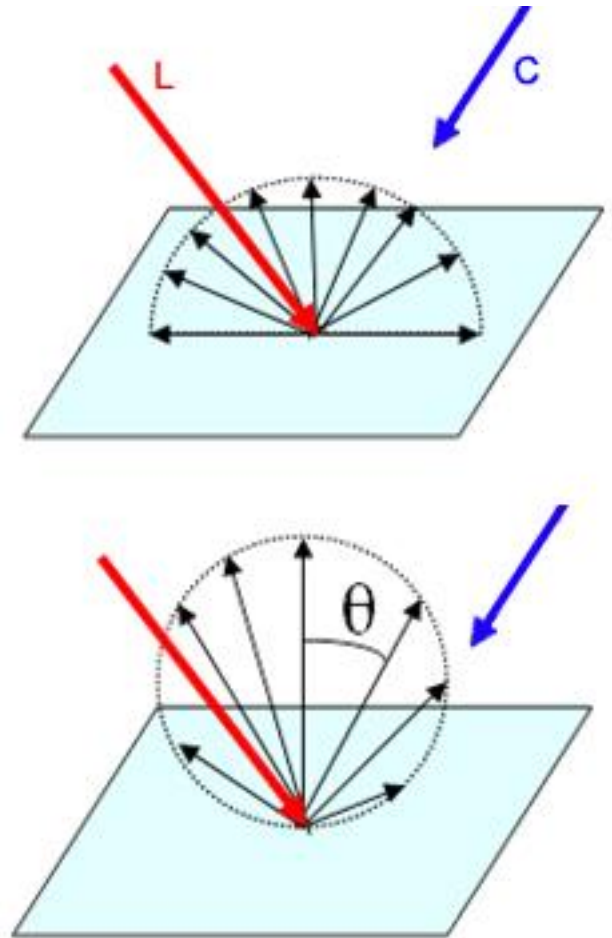
- ❑ Dome tradition : Material specscan not be covered by color alone
BRDF : *multi-camera + multi-light*
↓
- ❑ Minidome, Microdome.. : *single camera version with 260 LED lights.*
↑
- ❑ Resembles RTI/PTM but...



Reflectance Imaging for Cultural Heritage

RTI vs. Photometric stereo (PS) / BRDF analysis

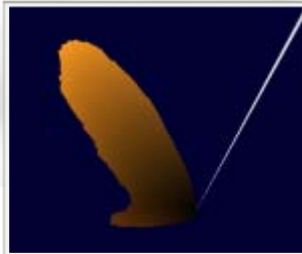
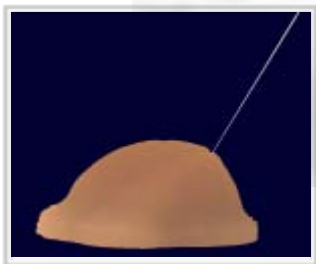
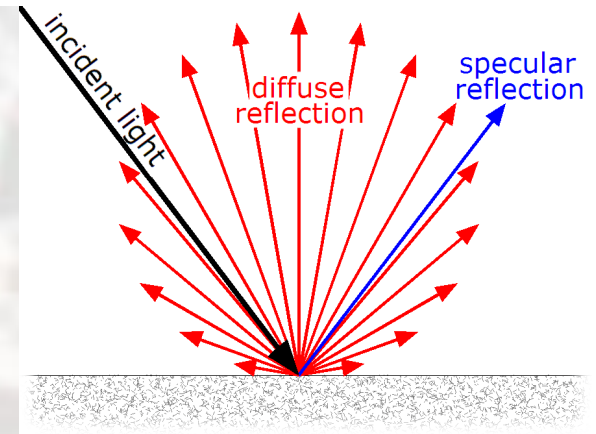
- ❑ PTM / RTI : parametric fitting of observations
- ❑ estimate the **surface normals** of objects by observing it under different lighting conditions, using physical laws of light and optics.
- ❑ PS: traditional diffuse objects (“Lambertian”)
- ❑ Extend to: specular, refraction, translucence, BRDF (bidirectional radial distribution function), surface filtering, material classification, etc..
- ❑ dynamic range, HDRI...
- ❑ Adaptive shutter...



Reflectance Imaging for Cultural Heritage

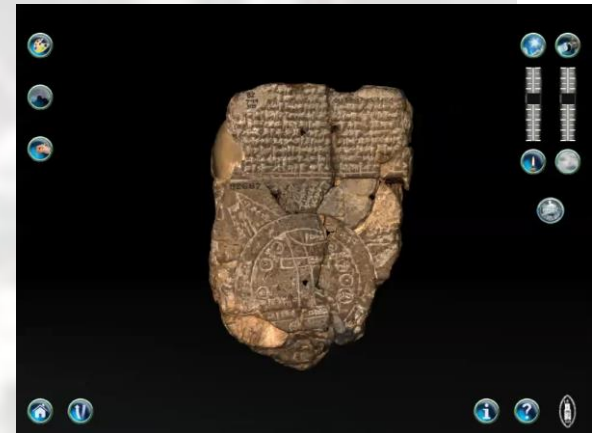
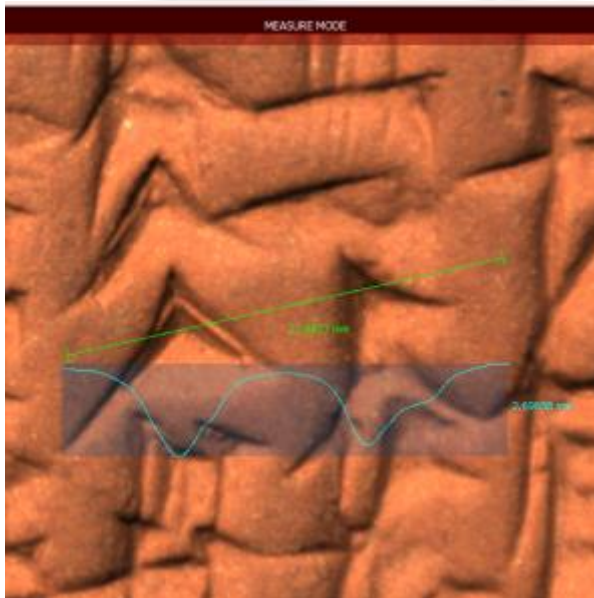
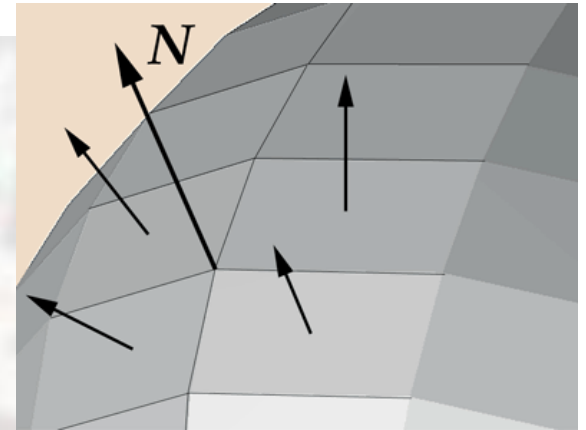
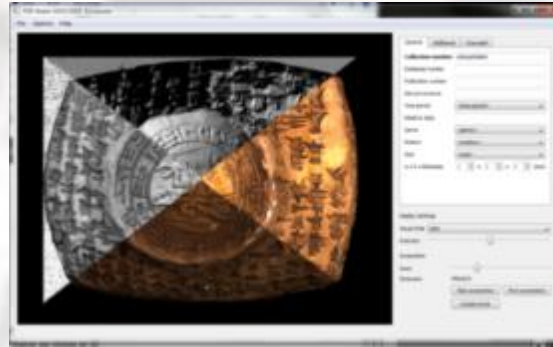
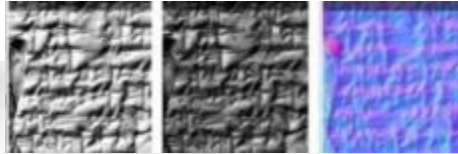
RTI vs. Photometric stereo (PS) / BRDF analysis

- ❑ **Surface normal**
- ❑ **Albedo : 'actual material color'**
- ❑ **Ambient color**
- ❑ **Specular, Fresnel, roughness and geometric parameters**
- ❑ **Translucency, transparency, iridescence..**
- ❑ **3D reconstruction... Measurements...**



Reflectance Imaging for Cultural Heritage

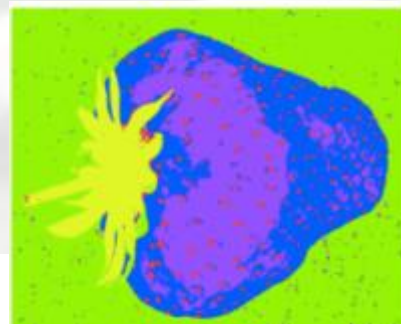
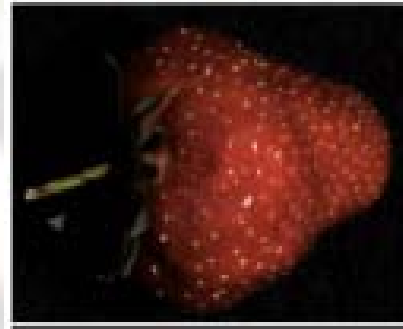
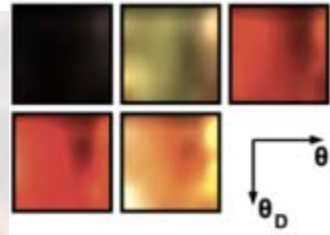
3D reconstruction / analysis / filtering



Reflectance Imaging for Cultural Heritage

Material/BRDF analysis

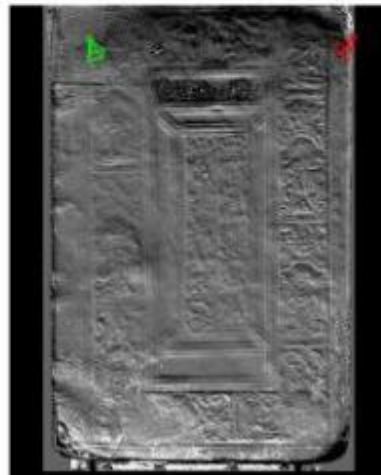
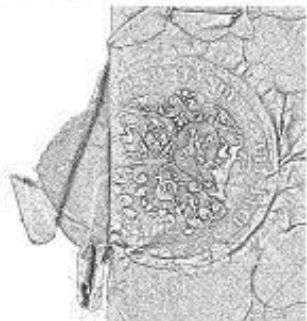
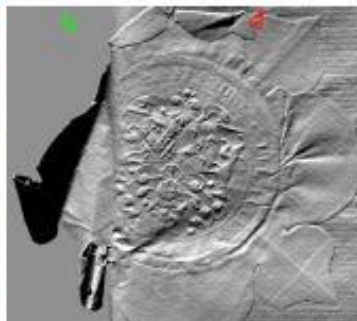
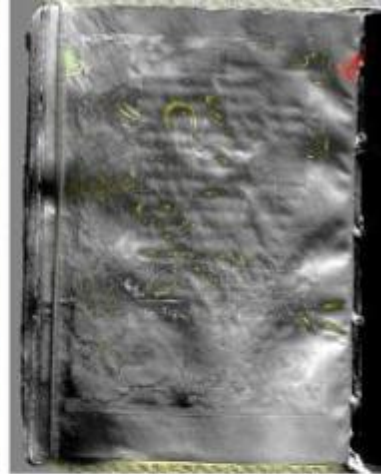
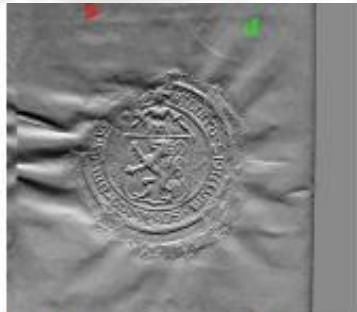
- ❑ Sparse BRDF estimation
- ❑ Material clustering
- ❑ Combine surface-material refinement



Reflectance Imaging for Cultural Heritage

Literature

- ❑ Booklets
- ❑ Manuscripts
- ❑ Stamps
- ❑ Seals



Minidome

context

principle

analysis

applications

Structured light / laser

Photogrammetry

Photometric stereo



applications

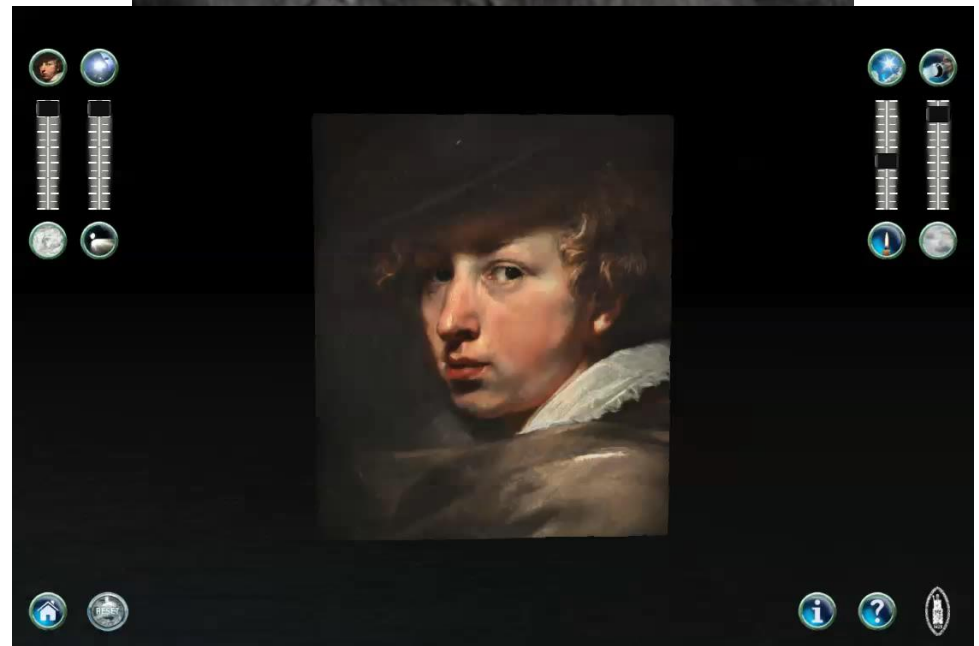
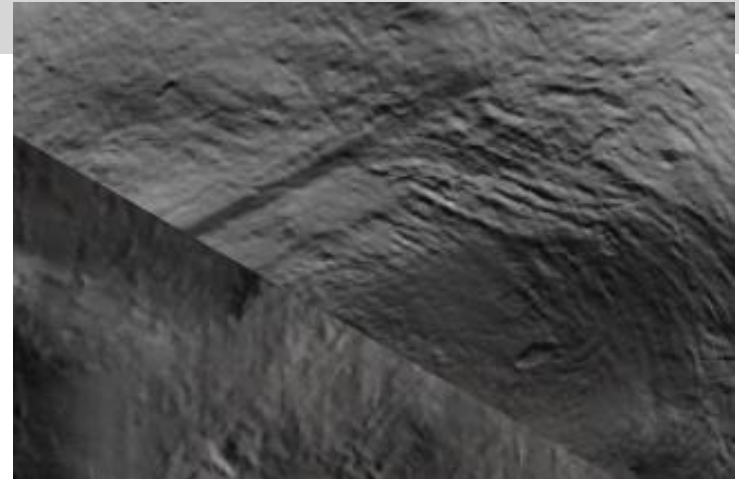
Coins

- specularity / reflections



Paintings

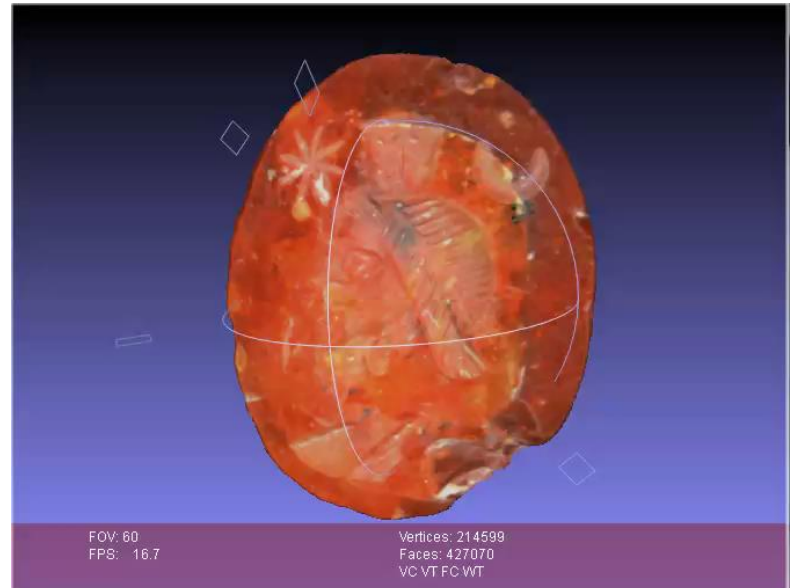
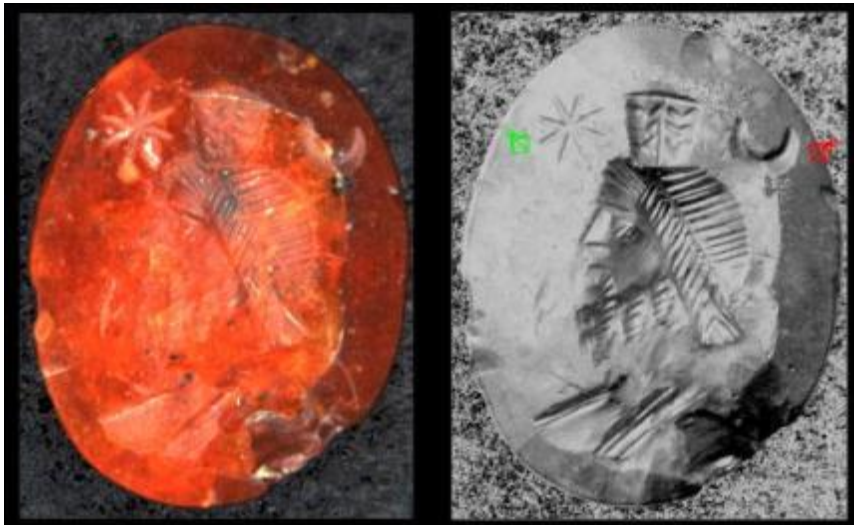
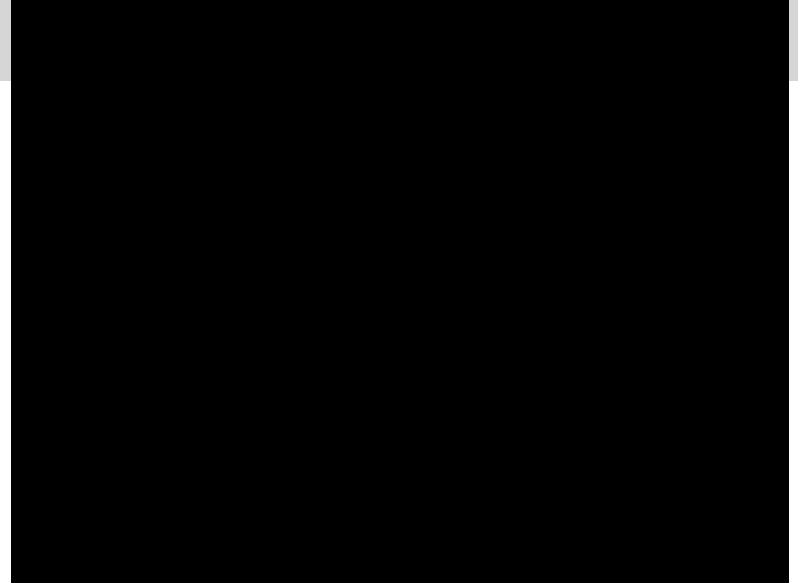
- ❑ Van Dyck painting : brushstrokes reveal history and possibly identity.



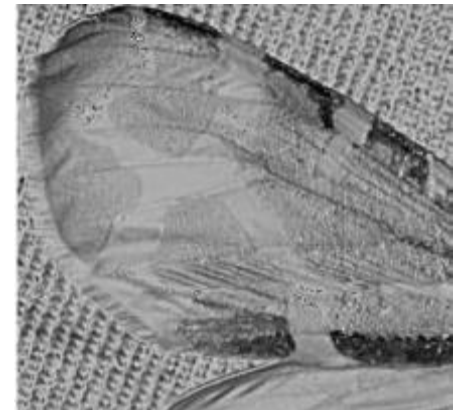
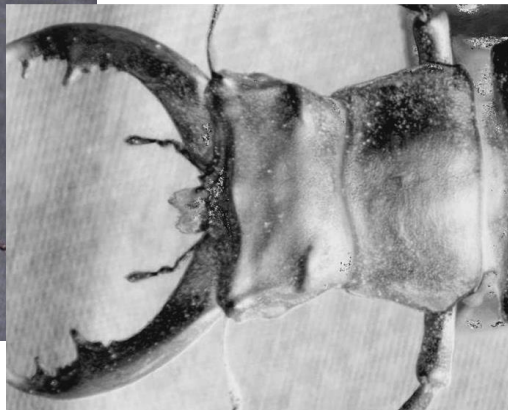
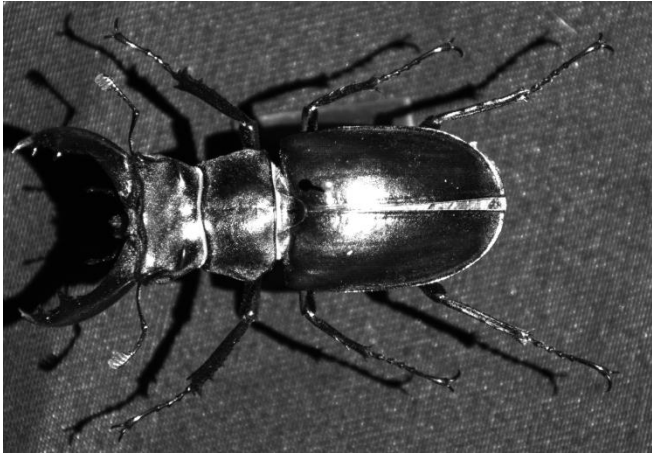
Minerals

❑ Chrystals

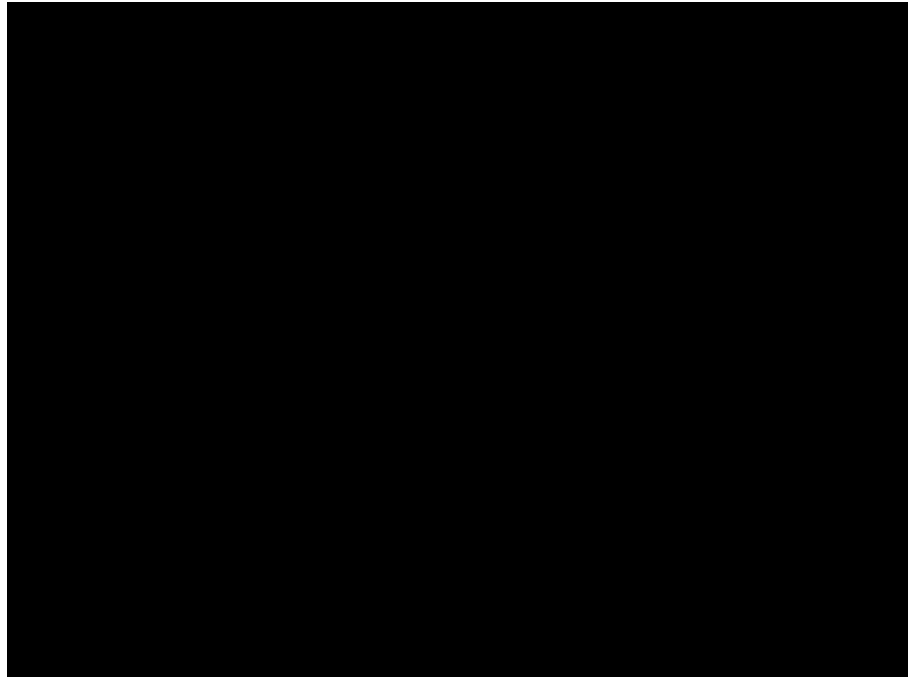
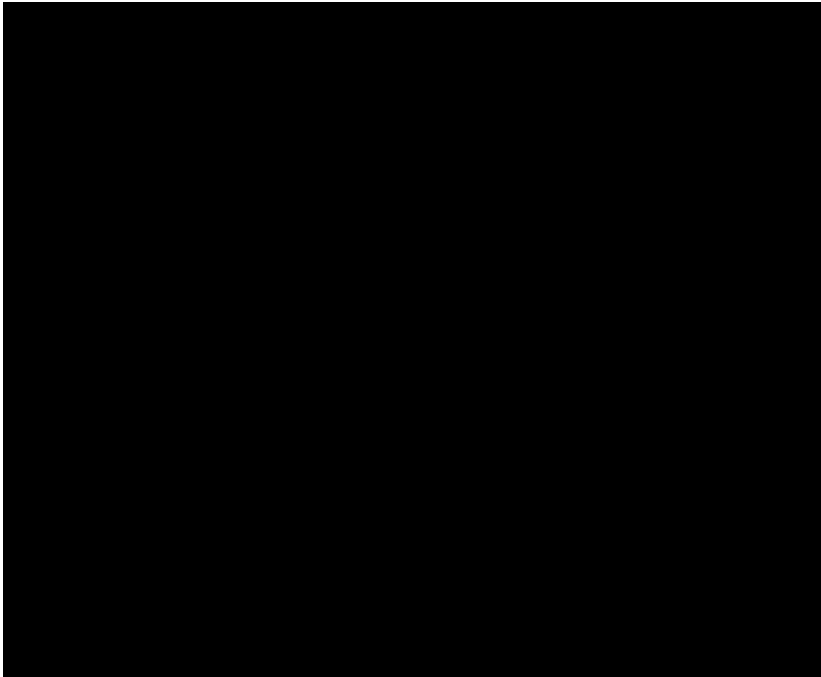
❑ Gems



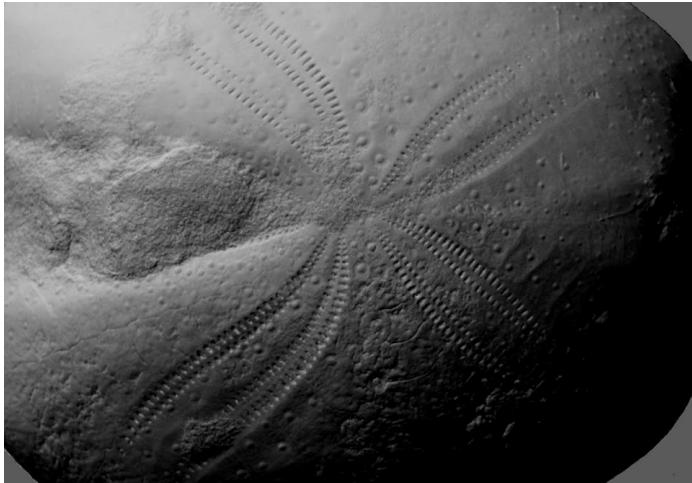
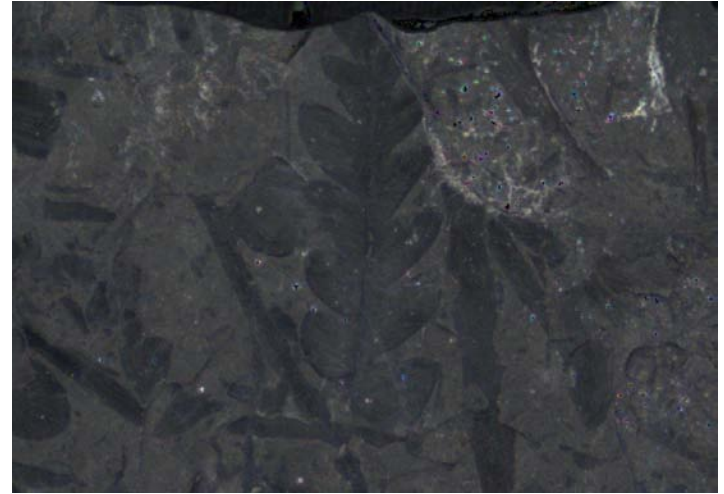
Entymology



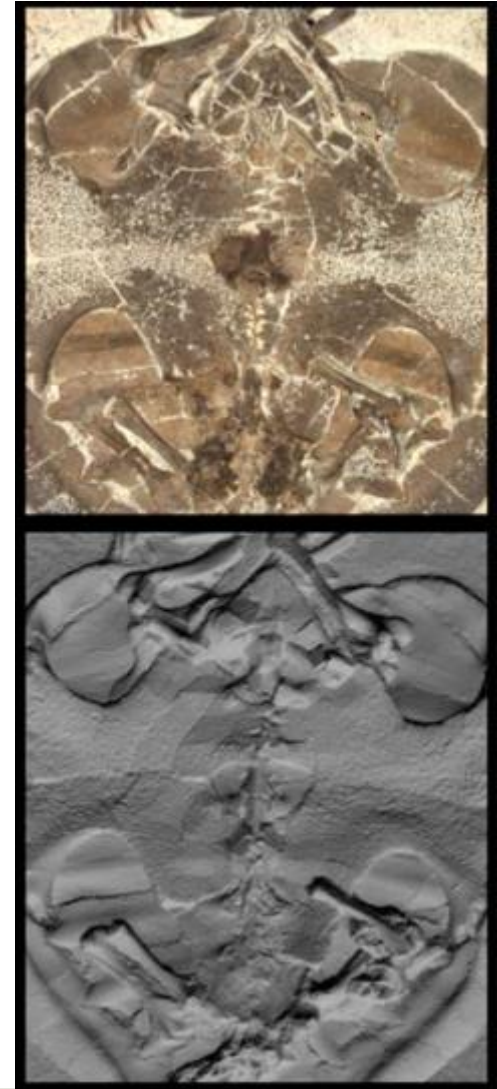
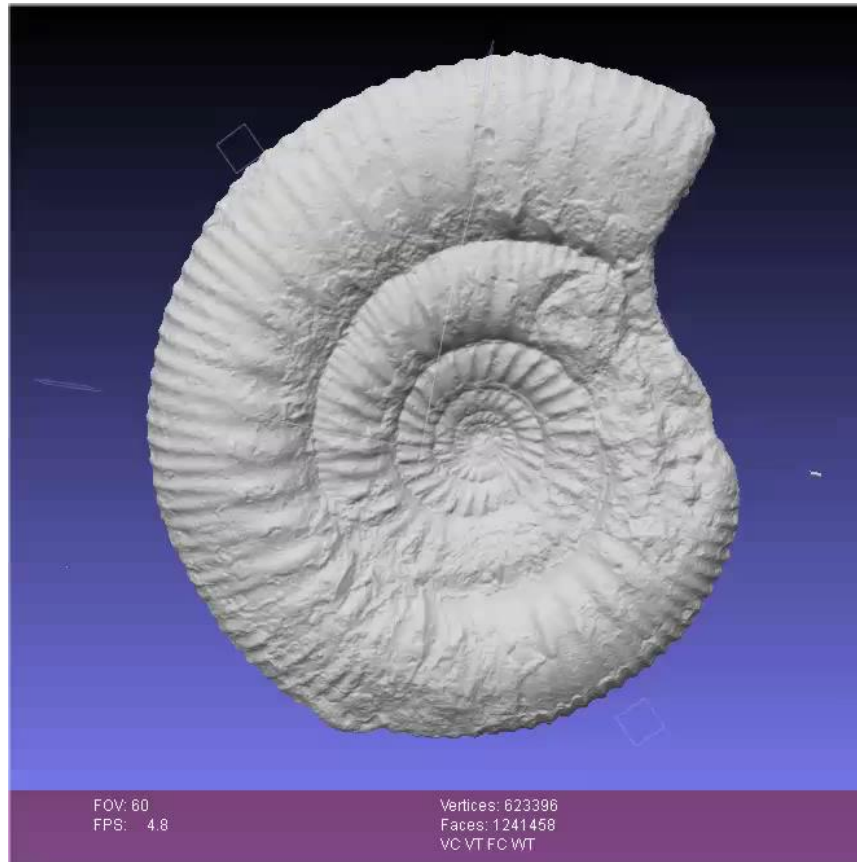
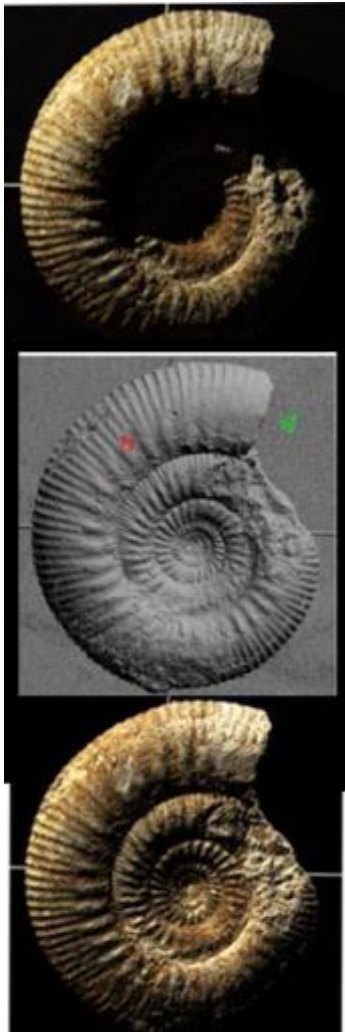
Flora / Botany / Plants



Fossils

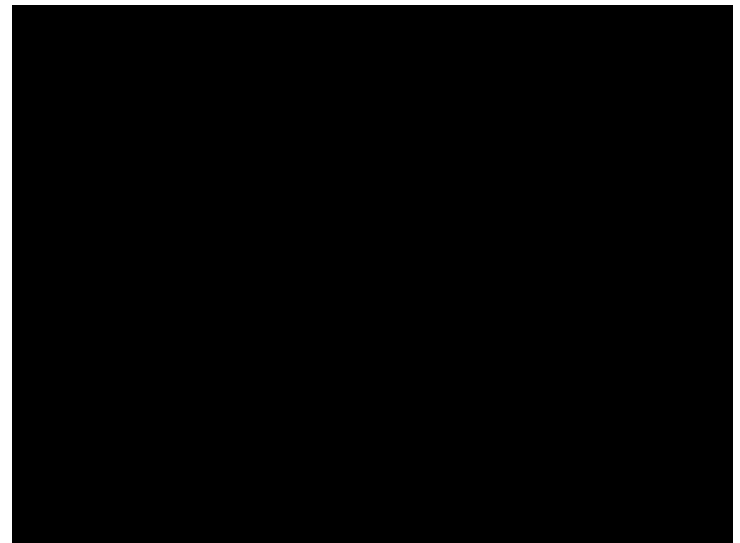


Fossils (NHMBerlin)



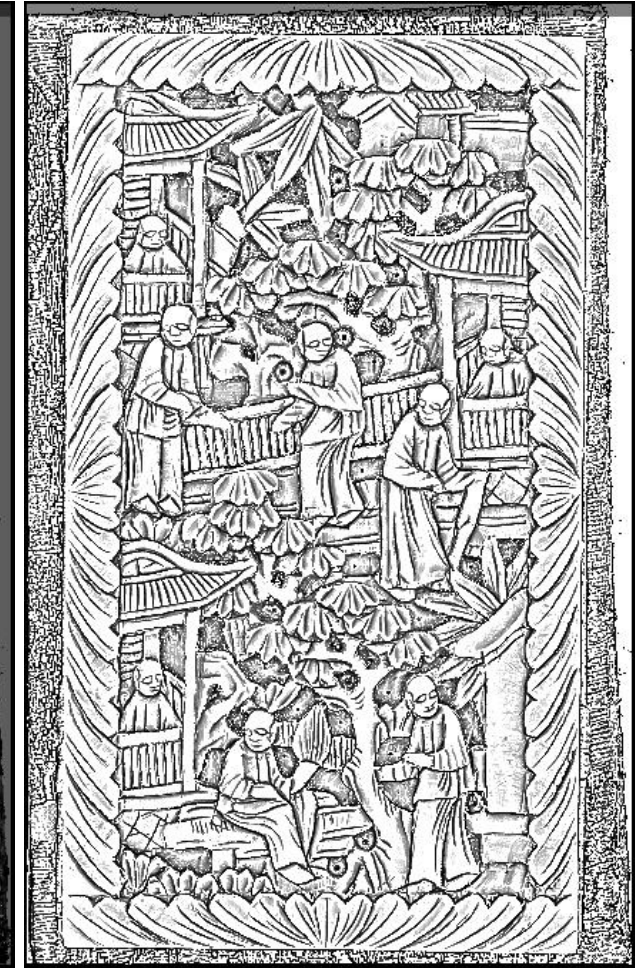
Antropology

❑ Ishango / Nutons bones / Oracle bones



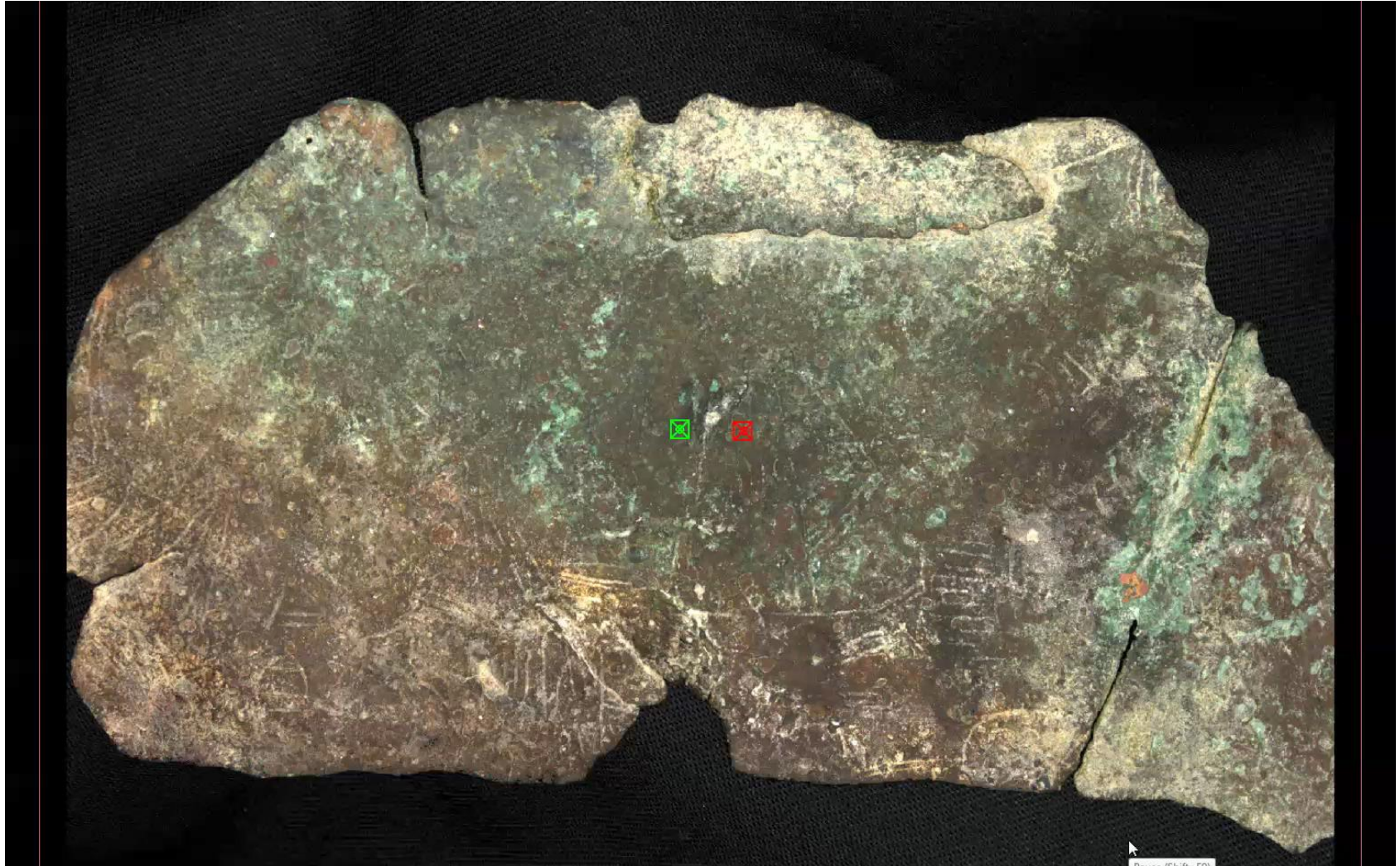
Antropology

□ Ivory piece



Antropology

□ Kelt graffiti plate



Reflectance Imaging for Cultural Heritage

